

CHAPTER 1. INTRODUCTION

1.1 Background

The systematic study of the taxa in any country adds vital information for writing the flora and knowing the status of the taxa. The systematic work can help in updating the enumeration. It further helps in finding the new locality, depositing new specimens in herbaria.

One important benefit of systematic work is to update the nomenclatural changes. It is even more difficult in developing country for systematic work as there are insufficient literatures and herbarium. Side by side, the systematic study adds more information or additional information on the floral biology during collection of the specimens.

It has been estimated that approximately 250,000 species of the vascular plants belonging to 428 families occur in the Earth (Mabberley, 1987). Koba *et al.*, 1994 enumerated 6537 taxa belonging to Angiosperms and Gymnosperms from Nepal.

Commelinaceae, commonly known as the spiderwort family, is a medium size family with 41 genera and 650 species worldwide (Kubitzia, 1998). Commelinaceae is distributed worldwide, mostly tropical and subtropical with considerable diversity extending into northern temperate regions. In Nepal, nine genus and twenty-two species have been enumerated (Press *et al.*, 2000).

Commelinaceae are dated to ca. 89 million years before present, divergence within it to ca. 62 million years before present (Faden, 1983); however, members of Cartonematoideae were not included in the study, so the latter date reflects divergence within Commelinoideae.

The major centers of diversity for the family Commelinaceae are Mexico (especially Oaxaca and Chiapas) and north Central America especially for the subtribe Tradescantiinae and Thysantheminae); tropical Africa (including Madagascar); and peninsular Thailand and southwestern China (especially for Commelinae, Cynotinae and Streptoliriinae). Commelinaceae are ecologically diverse (Kubitzia, 1998). They are found chiefly in humid and mesic habitats, such as forests and grassland.

The genera are largely tropical and subtropical but extend into temperate regions. The greatest diversity is in Africa, where, along with Madagascar, nearly half the genera and about 40% of the species are found (Faden, 1983). There is natural division of the taxa between Old and the New World.

The seven sub-tribes of the tribe Tradescantieae are each wholly confined either the Eastern or the Western hemisphere, whereas the tribe Commelineae is found mainly in Africa and Asia (Faden and Hunt, 1991). Only six genera have indigenous species in both hemispheres.

The minimum number of genera of Commelinaceae are reported from China and Ceylon (Table 1).



Fig. 1: Distribution Map of Commelinaceae in the World.

Although the number of genera and species are relatively less in Nepal, there need to be more extensive search for species of Commelinaceae in Nepal.

Commelina communis, commonly known as the Asiatic dayflower, which served as the type for the family Commelinaceae, is an herbaceous plant in the dayflower family Commelinaceae. It is native to East Asia and extending into South East Asia. It has also been introduced to parts of Europe and much of North America.

Linnaeus picked the name *Commelina* in honor of the three Dutch brothers of the Commelijn family, using the flower of *Commelina communis* to symbolize them. The large, blue petals represent the botanists Jan Commelijn and his nephew Kaspar, who

were famous for their work, while the small lower white petal symbolizes their brother who died at a young age (http://en.wikipedia.org/wiki/Commelina_caroliniana).

Some species of Commelinaceae have economic importance and some are medicinally important. Some species including *Commelina benghalensis*, *C. diffusa* etc. have antimicrobial activity (Parekh *et al.*, 2007). In some places, the paste of these species has been used in healing of wound.

The species of *Commelina benghalensis* and *C. diffusa* are common weed and are problematic in some places. However, these are also used as fodder. The local people in some places use the liquid in the spathe of *Commelina* believing that the liquid has antipyretic activity. However, the chemical test of the compound has not been done.

There are relatively less publications based on Commelinaceae. There have been some literatures, which have described some species of Commelinaceae. Carl Linnaeus (1753) has mentioned some species of *Commelina*.

D. Don (1825) described one species of *Commelina* (*C. longifolia*) and one of *Cyanotis* (*C. cristata*) of Nepal. Royle (1839) listed three species belonging to genera *Commelina* (*C. benghalensis*, *C. scapiflora*) and *Murdannia* (*M. scapiflora*) which are also found in Nepal.

Hooker (1892) described seven species of three genera including *Commelina* (*C. hasskarlii*, *C. benghalensis*, *C. suffruticosa*), *Cyanotis* (*C. vaga*, *C. cristata*, *C. axillaries*) and *Streptolirion volubile* which are also found in Nepal.

Rao (1964) listed two species belonging to two genera *Commelina* (*C. diffusa*), and *Pollia* (*Pollia hasskarlii*) which are also reported in Nepal. Hara (1966) described 13 species of seven genera *Amischotolype*, *Amischophacelus*, *Commelina*, *Murdannia*, *Cyanotis*, *Streptolirion*, and *Floscopa* of Himalaya, which also occur in Nepal.

Gandhi (1976) has mentioned eight species belonging to five genera *Amischophacelus* (*A. axillaries*), *Commelina* (*C. benghalensis*, *C. diffusa* and *C. paludosa*), *Cyanotis cristata*, *Floscopa scandens*, and *Murdannia* (*M. nudiflora* and *M. spirata*) which are

common to Nepal. Malla (DPR-1976) mentioned ten species of five genera including *Amischophacelus*, *Commelina*, *Murdannia*, *Cyanotis vaga*, and *Floscopa*.

Hara *et al.* (1978) has enumerated 21 species of nine genera, which include *Amischophacelus* (*A. axillaris*), *Amischotolype* (*A. hookeri*), *Commelina* (*C. benghalensis*, *C. diffusa*, *C. hasskarlii*, *C. maculata*, *C. paludosa*, *C. suffruticosa*), *Cyanotis* (*C. cristata*, *C. vaga*), *Dictyospermum* (*D. scaberrimum*), *Floscopa* (*F. scandens*), *Murdannia* (*M. blumei*, *M. divergens*, *M. japonica*, *M. keisak*, *M. nudiflora*, *M. scapiflora*, *M. spirata*), *Polia* (*P. hasskarlii*) and *Streptolirion* (*S. volubile*).

Karthikeyan *et al.* (1989) enumerated eighteen species belonging to seven genera *Amischotolype hookeri*, *Amischophacelus axillaries*, *Commelina* (*C. benghalensis*, *C. diffusa*, *C. hasskarlii*, *C. suffruticosa*, *C. maculata*, *C. paludosa*), *Murdannia* (*M. spirata*, *M. nudiflora*, *M. divergens*, *M. keisak*, *M. blumei*, *M. scapiflora*), *Cyanotis* (*C. vaga*, *C. cristata*), *Polia japonica*, and *Streptolirion volubile* which also occur in Nepal.

Mandal (In: Hajra and Verma, 1996) mentioned 17 species of nine genera, which include *Amischophacelus* (*A. axillaris*), *Amischotolype* (*A. hookeri*), *Commelina* (*C. benghalensis*, *C. diffusa*, *C. hasskarlii*, *C. paludosa*, *C. suffruticosa*), *Cyanotis* (*C. cristata*, *C. vaga*), *Rhopalephora* (*R. scaberrimum*), *Floscopa* (*F. scandens*), *Murdannia* (*M. divergens*, *M. japonica*, *M. nudiflora*, *M. edulis*, *M. spirata*) and *Polia* (*P. hasskarlii*) which are found in Nepal as well.

Gaur (1999) listed 11 species of four genera, which include *Commelina* (*C. benghalensis*, *C. diffusa*, *C. hasskarlii* and *C. maculata*), *Cyanotis* (*C. cristata*, *C. vaga*), *Murdannia* (*M. divergens*, *M. nudiflora*, *M. edulis*, *M. spirata*) and *Floscopa* (*F. scandens*) which are also in Nepal.

Press *et al.* (2000) has listed 22 species belonging to nine genera similar to Hara *et al.* (1978). Polumin and Stainton (1984) have listed two genera and two species (*Commelina paludosa* and *Cyanotis vaga*). Malla *et al.* (1986) described six species of four genera *Commelina*, *Murdannia*, *Cyanotis vaga*, and *Floscopa*.

Noltie (2000) has described 17 species of seven genera which are also reported in Nepal including *Commelina* (*C. benghalensis*, *C. diffusa*, *C. caroliniana*, *C. suffruticosa*, *C. maculate*, *C. paludosa*), *Pollia japonica* and *Rhopalephora*, *Murdannia* (*M. spirata*, *M. nudiflora*, *M. divergens*, *M. japonica*), *Amischotolype hookeri*, *Cyanotis* (*C. vaga*, *C. cristata*, *C. axillaries*) and *Streptolirion volubile*.

Mahato (2006) has mentioned two genera and two species (*Cyanotis vaga* and *Commelina benghalensis*) from Palpa district, Nepal.

1.2 Diagnostic Characters of Commelinaceae

The stems of these plants are generally well developed, and often swollen at the nodes. Flowers are often short-lived, lasting for a day or less with mucilaginous, slimy sap. The alternate, entire, and monocot-like leaves include a sheathing base that is often enclosed around swollen nodes that produce a 'jointed stem'. While normally actinomorphic, some genera show reduction of one petal to produce zygomorphy.

The flowers or inflorescences are often subtended by a spathe. The sepals, often green, are distinct from the petals, which, due to their thin, delicate structure, are often ephemeral. Many genera have masses of multicellular trichomes attached to the filaments and a set of the six stamens often shows some type of modification (staminodes). Ovary is superior, style long and with axile placentation. The fruit is capsule.

Anatomical characters of Commelinaceae are also very important during systematic study. Stomata with large guard cells surrounded by (2-) 4-6 shallow subsidiary cells developing in a fixed way from cells adjacent to the guard mother cells. Stem with a distinctive arrangement of variable bundles differing from all other monocotyledons; usually including hypodermal collenchyma (Tomlinson, 1966).

Pollen evidence can be valuable in solving problems of classification at tribal and sub-tribal levels. The pollen is very variable in size between and to a limited extent, within genera. Pollen grains in family Commelinaceae are single, heteropolar and monosulcate, although some variation can be seen (Hunt and Poole, 1979).

The cladistic studies on the characters of the genera of Commelinaceae showed that morphological characters were not very good for demonstrating relationships among the genera. Instead, DNA sequence data, using the *rbcL* gene could be much more helpful (Evans *et al.*, 2000).

1.3 Classification of Commelinaceae

There are several classification systems based on Commelinaceae published in different literatures. Bentham and Hooker (1862-1883) kept Commelinaceae in series Coronarieae.

Meisner (1842), who used Tribe Commelineae and tribe Tradescantieae, did the first division of the family into tribes. Hasskarl (1870) used Meisner's system defining two tribes essentially the same. Similarly, Clarke (1881) recognized a small third tribe Polлиеae.

Engler (1930) treated in division Embryophyta within subdivision Angiospermae with class Monocotyledoneae of order Commelinales. Bruckner (1926, 1930) raised the two major divisions Commelineae and Tradescantieae.

J. Hutchinson (1973) treated Commelinaceae in Subdivision Calyciferae of order Commelinales. Cronquist (1981) treated Commelinaceae in Commelinales of Commelinidae. Thorne (1983) treated Commelinaceae in Commeliniflorae (within Commelinales). Dahlgren (1983) treated Commelinaceae in Commelinales of Commelinaflorae.

Takhtajan (1997) treated Commelinaceae in Commelineae of order Commelinales within Commelinanae. Phylogeny Group System of Flowering Plant Classification (APG 1998), Commelinaceae has been treated in Commelinales (within Commelinoides). Judd *et al.* (1999) treated Commelinaceae in Commelinales.

However, Faden and Hunt (1991) proposed a new classification of Commelinaceae above the generic level. Within family Commelinaceae, two sub-families recognized Cartonematoideae and Commeliinoideae. The sub-family Commelinoideae is divided into two tribes Tradescantieae and Commelineae. In this classification, anatomical, palynological and cytological characters in addition with morphological characters are used.

1.4 Objectives

There has been very few works done in the members of Commelinaceae in Nepal. Most of the works are confined to enumeration and local floras. The members of the family Commelinaceae are one of the most neglected group during collection. Because of the lack of knowledge about floral biology of members belonging to family Commelinaceae, most of the herbarium lack flowers in the herbarium. For this reason, the present study has been carried out to accomplish the following objectives:

- a. To examine herbarium specimens deposited at KATH and TUCH; to collect fresh specimens and prepare best quality herbarium specimens.
- b. To prepare the taxonomic treatment and distribution maps of the genera and species of family Commelinaceae in Nepal.
- c. To update the nomenclatural changes of the taxa and enumeration of taxa of the family Commelinaceae in Nepal.
- d. To study anatomical characters, pollen characters and phytochemistry of the members of Commelinaceae.
- e. To perform cluster analysis (numerical taxonomy) of the Nepalese genera of Commelinaceae based on morphological and anatomical characters.

1.5 Hypothesis

The systematic work on Commelinaceae in Nepal has not been done previously. Such work is necessary and will be useful in flora writing. The work will not only focus in systematic study based on morphology, rather it will combine anatomical,

morphological and palynology (new method based on different chemical) and photochemical tests.

It is expected from the study that a nice taxonomic treatment of the species will be done along with all information about current status of the family Commelinaceae in Nepal. From the exploration of different places, it is believed that new records will also be found during the study.

1.6 Justification

Exploring the biodiversity helps in supplying practical knowledge. It is very important for a nation to enumerate the plants found in the country and provides good taxonomic treatment focusing on conservation of the plants.

The systematic work also helps in the enumeration, updating nomenclature change and adding specimens in herbaria. It further helps in adding information about uses, floral biology, etc. Thus, overall aim is systematic study based on morphology along with anatomical, morphological and palynology (new method based on different chemical); along with phytochemical tests as far as possible.

1.7 Limitation of the Study

A detailed systematic works require a good stock of herbarium, type specimens, literatures, recent collections and chemicals for pollen analysis. However, all of above are in poor condition in our country in relation to Commelinaceae. The preservation of the flowers of species of the Commelinaceae is extremely difficult. And most of the species on the herbarium lack the flower. The collection of the species of the Commelinaceae has been done as far as possible. This helped in understanding variation in many species. Because of shortage of time, it was not possible to study specimens from the other herbaria. Similarly, collections were done only from Central and Eastern Nepal. However, digital images of some species of Commelinaceae were studied from K and NY. The study helped in depositing many species which were not deposited previously in herbaria of Nepal.

CHAPTER 2. MATERIALS AND METHODS

The general taxonomic work was primarily done based on the gross morphological characters obtained from the herbarium deposited and fresh collections. After conducting the morphological work, the work based on anatomy, pollens, phytochemical tests and cluster analysis were done.

Before starting the study, the deposited herbarium at TUCH and KATH were examined and taken photographs. It helped in understanding the locality of the certain species of Commelinaceae. Then several literatures were studied related to different species of Commelinaceae. It helped in noting the phenology. The major study on anatomy, pollen and phytochemical tests were based on fresh collections and the deposited herbarium.

2.1 Collection and Preparation of Herbarium

The plants of Commelinaceae were collected from different location in Nepal. The collections were more from Central and Eastern Nepal covering 14 districts. Due to shortage of time, no collections have been done from the Western Nepal. Collection and preparation of herbarium is the most important part in systematic study. Therefore more emphasis was given for this.

Plant specimens with their reproductive parts were collected as far as possible and photographs were taken. Field notes of all the species were completed in the field along with tagging and numbering was done. While preparing the field note, following points were noted like date of collection, collection no, locality, local name, associated species, vegetation, color of the flower, uses etc.

The plant species collected were pressed immediately in the field press. Then transferred and pressed in a herbarium press and dried on a newspaper. At first card board was placed on the herbarium press; and plant kept on newspaper was placed in between the cardboards. The same process was followed and finally the press was tightened with nylon band.

The well-dried plant specimens were mounted on a herbarium sheets with proper arrangement with favicol or glue. The dropped materials, cut pieces, flowers, fruits, etc were kept in envelopes in the side of a herbarium sheet as capsule.

Preservation

The plant collected can be liquid-preserved. The best liquid to use is FAA [1 part by volume formalin solution: 1 part glacial acetic acid: 18 parts 70% ethanol].

As flower is very difficult to preserve, a new method has been applied by keeping blotter at base, then flowers and covered by non-sticky transparent plastic. The colours of petals retained even for more than a year by preserving the flower through this process. Numbering was also done in such plastic bags. This method helped in great deal in preservation of the flower in the herbarium.

2.2 Morphological Study

The morphological study of the herbarium specimen was done with the help of stereomicroscope, dissecting-microscope and available literatures. The dissected flowers were arranged in a piece of paper and attached in it. The parts of the herbarium studied were kept in small packet and attached in the respective herbarium sheets.

2.3 Identification

The herbarium specimens were identified with the help of available literatures. Some specimens were verified as well as identified by Dr. Robert B. Faden, Department of Botany, Smithsonian Institution, Washington DC, U.S.A. During identification, the collected specimens were compared with specimens deposited at TUCH, National Herbarium Centre and Plant Laboratories (KATH), Godawari. Some herbarium specimens, which were not collected and present at KATH were confirmed by different literatures.

2.4 Illustrations and Photographs

Free hand diagrams were prepared based on the herbarium specimens studied. The diagram included habit, floral parts, etc. Photographs were being taken as far as possible and were included wherever necessary.

2.5 Anatomical Study

The anatomical study of stem and leaf was also done to see if these characters are taxonomically significant. However, such study is restricted to some genera and species, due to shortage of the specimens. The different requirements and the details of method of anatomical study are listed in APPENDIX (B).

2.6 Pollen analysis

Since the chemicals required for analysis of pollen by acetolysis and enzyme based methods are unavailable, so a new method has been applied to study the pollens in some species of Commelinaceae. In the new method, Benzoyl Peroxide has been used, which seem to be very useful in analysis of fragile pollens.

Due to lack of enough material, only the genera *Commelina*, *Murdannia* and *Cyanotis* were analyzed. Within these genera, only analysis was done to those having pollen. The different requirements and the details of method of pollen analysis are listed in APPENDIX (C).

2.7 Phytochemical Tests

The Phytochemical tests of some species of the selected genus were done. For this, the standard methods were applied. Due to lack of enough material, only the genera *Commelina*, *Murdannia* and *Cyanotis* were analyzed. The phytochemical tests were based on genus level only.

The different requirements and the details of method of phytochemical tests are listed in APPENDIX (D).

2.8 Cluster analysis: Dendrogram

The numerical taxonomy involves numerical evaluation of the similarities or affinities between taxonomic units. The use of the modern electronic data-processing techniques and several other programs have helped in numerical taxonomy.

Present study attempts the cluster analysis (numerical taxonomy) of the Nepalese species on the basis of morphological and anatomical characters. The purpose of this analysis is to explore the possibility of finding possibility groups that may also be useful when compared with works done out of Nepal or in other regions.

2.8.1 Character Coding

Character Coding was done based upon Evans *et al.* (2000) and Faden *et al.* (1999). The characters and character states were chosen based upon their consistency traced in the present study. For this, 23 characters were selected. Both two state coding and multistate coding was done as per the requirement during the analysis. In this analysis, a single species was scored for each genus where possible. For those species whose specimens are not available, the secondary source of information has been utilized. The details of the character coding are given in APPENDIX (E).

2.8.2 Operational Taxonomic Unit (OTU)

Operational Taxonomic Unit (OTU) is assumed that the units being examined have all descendent from a most recent common ancestor and represent distinct evolutionary entities. The outgroups *Heteranthera* (Pontederiaceae) and *Haemodorum* (Haemodoraceae) have been selected based on the recent molecular studies on monocotyledons (Chase *et al.*, 1995 and Clarke *et al.* 1993).

2.8.3 Data Analysis

Data analysis was done by statistical tool SPSS 11.5. Hierarchical cluster analysis was done using dendrogram as an option. For clustering method, nearest neighbor option was selected. The results of the analysis was compared with other similar analysis. The details of the clusters analysis consisting variables entry and data are given in APPENDIX (E).

CHAPTER 3. RESULTS

3.1. Range of morphological characters in Commelinaceae

The morphology of the plant has been studied from the fields, herbariums and different literatures. The primary source of information has been derived from the field and the herbarium of the species belonging to the family Commelinaceae. For the species whose specimens are not deposited in herbaria of Nepal, the secondary source of information (literatures) has been utilized. Followings are the range of morphology in species and genera of Commelinaceae in Nepal.

3.1.1. Habit

The plants of Commelinaceae are usually terrestrial and herbaceous. Majority of them are perennial (*Amischotolype*, *Rhopalephora*, *Floscopa*, *Pollia*, and *Streptolirion*), however, some are both annual and perennial (*Commelina*, *Cyanotis*, and *Murdannia*). Among *Commelina*, annuals are *Commelina diffusa* and *C. caroliniana* and perennials are *Commelina benghalensis*, *C. maculata*, *C. paludosa* and *C. suffruticosa*.

Among the *Cyanotis*, the perennials are *Cyanotis fasciculata*, *C. cristata* and *C. axillaries*; while *Cyanotis vaga* is annual. Among the *Murdannia*, annuals are *Murdannia blumei*, *M. keisak*, *M. nudiflora*, and *M. spirata*, whereas, perennials are *Murdannia divergens*, *M. japonica*, and *M. scapiflora*. Climbers are uncommon in Commelinaceae but *Streptolirion* is climber.

3.1.2. Roots

The roots of species of Commelinaceae are fibrous or fusiform and sometimes tuberous. All above-mentioned forms are seen in the species of *Murdannia*, while roots are fibrous in *Cyanotis*, and both fibrous as well as tuberous in *Commelina*. Fibrous roots are also found in *Amischotolype*, *Rhopalephora*, *Floscopa*, *Pollia*, and *Streptolirion*.

3.1.3. Stems

The stem is elongate, rounded, solid, nodes swollen or brittle in almost all genera and species of Commelinaceae.

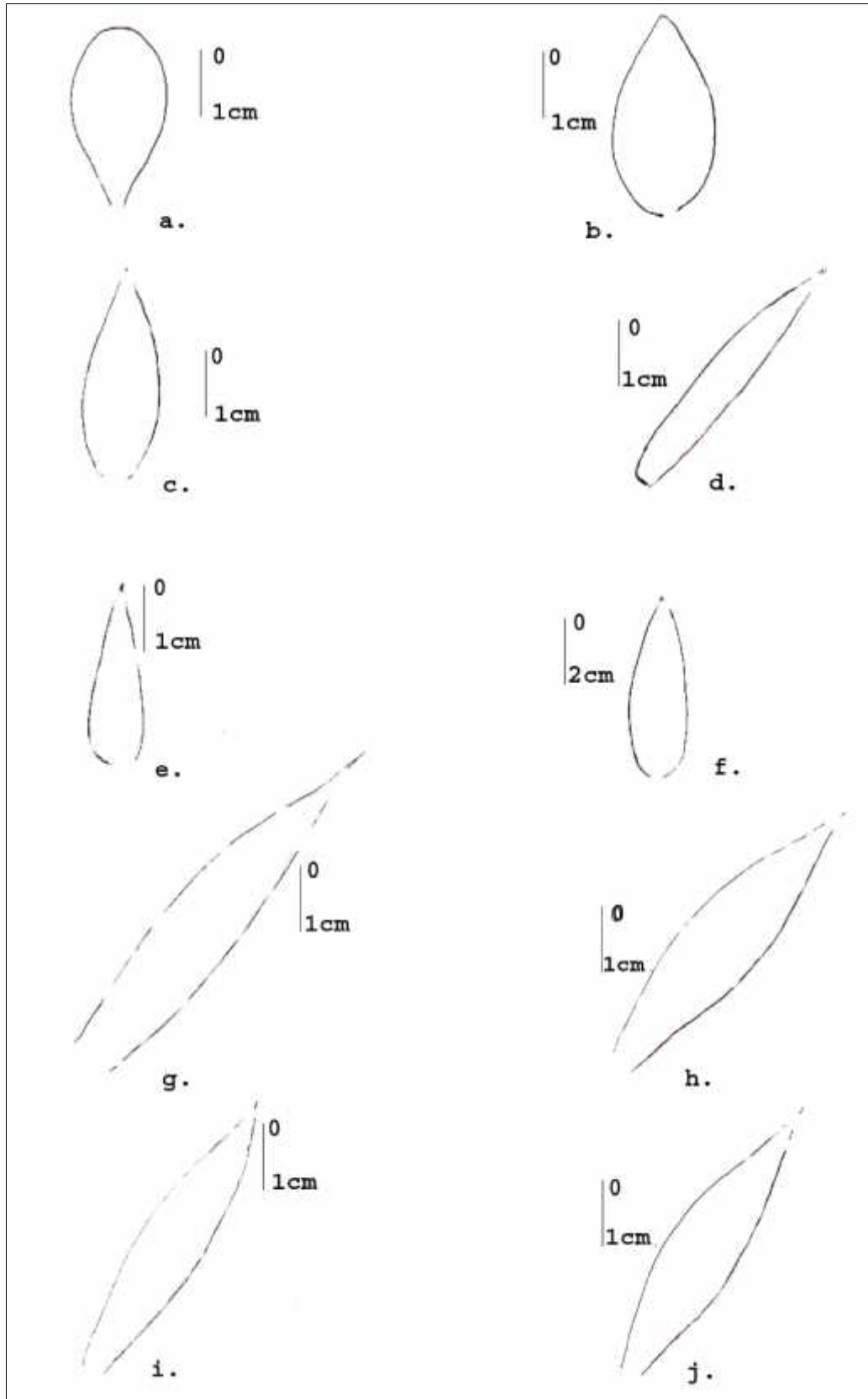


Fig. 2. Variation in leaves (a-j): a. *Commelina benghalensis* L., b. *C. benghalensis* L., c. *C. maculata* Edgew., d. *C. appendiculata* C.B. Clarke Edgew., e. *C. diffusa* N. L. Burman, f. *C. caroliniana* Walter, g. *C. paludosa* Blume, Enum., h. *C. suffruticosa* Blume, i. *M. keisak* (Hassk.) Hand.-Mazz., j. *Murdannia edulis* (Stokes) Faden.

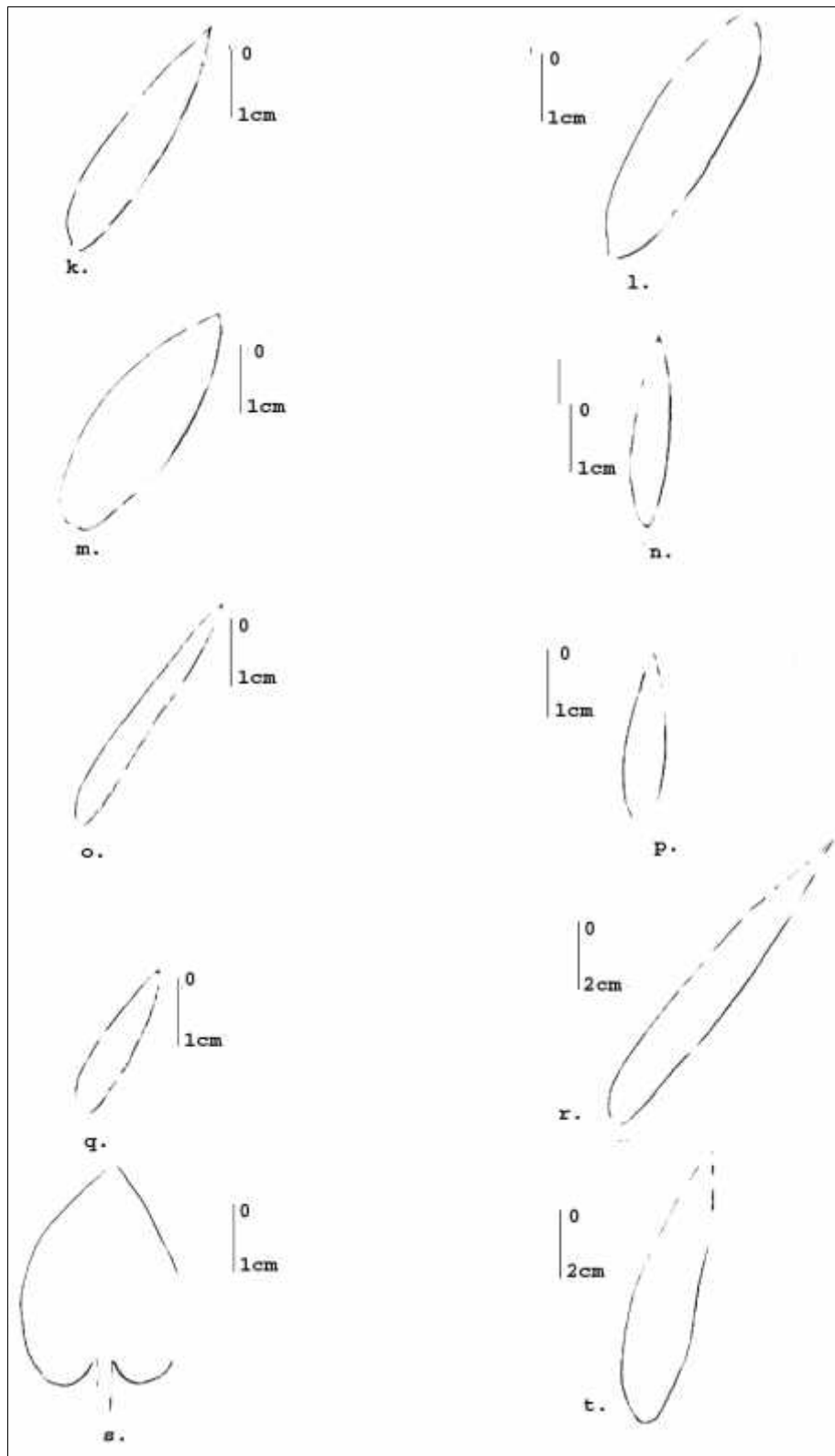


Fig. 3. Variation in leaves (k-t): k. *C. fasciculata* (Hayne ex Roth) Schultes f., l. *Cyanotis cristata* (L.) D. Don, m. *Commelina ensifolia* R. Br., n. *M. spirata* (L.) Bruckn., o. *Murdannia nudiflora* (L.) Brenan., p. *Murdannia dimorphoides* Faden, q. *Cyanotis arachnoidea* C.B. Clarke, r. *Rhopalephora scaberrima* (Blume) Faden, s. *Streptolirion volubile* Edgew., t. *Pollia hasskarlii* Hook.

3.1.4. Leaves

The leaves are petiolate, sheathing at base and sheaths (The summit of the sheath of *Commelina benghalensis*, *C. maculata*, *C. appendiculata* and *C. paludosa* bear reddish brown hairs) are closed, Leaves - simple, cauline and alternate (*Amischotolype*, *Floscopa*, *Murdannia*, *Pollia* and *Streptolirion*) or spiral (*Commelina*, *Rhopalephora* and *Cyanotis*). The leaves of *Cyanotis cristata* is succulent, and the leaf margins are entire (Fig. 2 and 3).

3.1.5. Inflorescence

The inflorescence is terminal (*Amischotolype*, *Commelina*, and *Pollia*) or axillary and in some both types (*Cyanotis*, *Rhopalephora*). In some genera the inflorescence is solitary (*Murdannia*, *Streptolirion*), while in *Floscopa* the inflorescence is broom like (Fig. 21). All are bracteate, cymes, subtended by large spathe (leaf-like bract), and bracts brightly colored.

The spathe of *Commelina benghalensis*, *C. maculata* and *C. paludosa* is funnel form (margin fused), while that of the *C. diffusa*, *C. caroliniana* and *C. suffruticosa* have conduplicate spathe. Similarly, the spathe of *C. benghalensis*, *C. maculata* and *C. suffruticosa* is pubescent while that of *C. paludosa*, *C. diffusa* and *C. caroliniana* is glabrous (fig. 4).

3.1.6. Flowers

Flowers pedicellate, bisexual, perianth is distinct. Flowers are small trimerous, and actinomorphic (*Amischotolype*, *Cyanotis*, *Floscopa*, *Murdannia*, *Pollia*, and *Streptolirion* or zygomorphic (*Commelina*, *Rhopalephora*). The flowers are variously coloured. The flowers are usually blue. In *Cyanotis*, some collectons contain pink flowers as well.

Sepals

Sepals distinguishable from petals, green, free. The sepals are usually green in colour (fig. 5).

Petals

Petals 3, free or tubular (*Cyanotis* and in *C. vaga*, the number of petal is 4 in some localities). The outer two petals may be narrower (*Floscopa*). The third petal is clawed (except *Rhopalephora*); and in *Commelina*, the third petal is small. The colour of petals



a



b



c



d



e



f



g

Fig. 4. Variation in Spathe in *Commelina*: a. *Commelina benghalensis* L., b. *C. paludosa* Blume, c. *C. diffusa* N. L. Burman, d. *C. caroliniana* Walter, e. *C. maculata* Edgew., f. *C. suffruticosa* Blume. , g. *Commelina appendiculata* C.B. Clarke

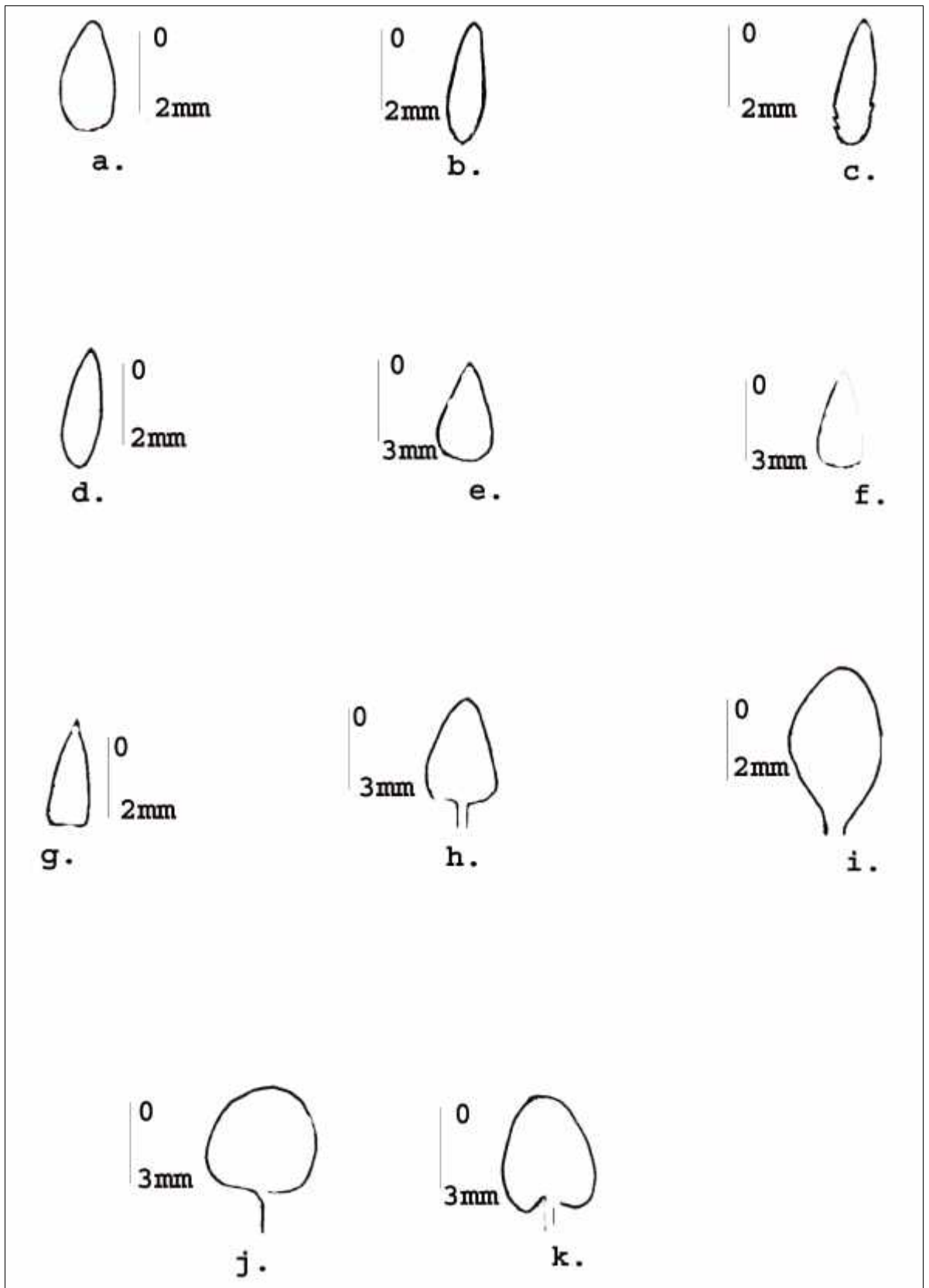


Fig. 5. Variation in sepals(a-g) and petals(h-k): a. *Rhopalephora*, b. *Pollia*, c. *Floscopa*, d. *Streptolirion*, e. *Murdannia*, f. *Cyanotis*, g. *Commelina*, h. *Commelina maculata* Edgew., i. *C. paludosa* Blume, j. *C. benghalensis* L., k. *C. diffusa* N. L. Burman

may be white (to pinkish) and blue (fig. 5). However, fain blue and deep blue to white are the range of colours of petals. In some collections of *Cyanotis*, the petals are pink.

Stamens

Stamens 3 or 6 (3+3), filaments hairy or glabrous. The stamens may be all fertile (*Amischotholype*, *Cyanotis*, *Rhopalephora*, *Floscopa*, *Polliia* and *Streptolirion*) or staminodes present in *Commelina* and *Murdannia*.

The staminodes are trilobed in *Murdannia* while cruciform in *Commelina*. The stamens of *Cyanotis* are hairy. The stamens in *Cyanotis cristata*, *C. vaga* and *C. axillaris* have sub apical swelling, while *Cyanotis fasciculata* and *C. arachnoidea* lack such swelling. Among *Murdannia*, only *M. blumei* has glabrous stamens while others have hairs at base.

Ovary

Carpels 3, united, ovary superior and style is one. The style is simple, unbranched and slender. The Stigma is capitate and placentation is axile. The ovary is bi-tri locular and ovules may be uni-seriate or bi-seriate.

3.1.7. Fruit

The fruit of Commelinaceae is a capsule and it may be of various shapes ranging from oblong, elliptic to obovoid. *Amischotholype* has 3-valved capsule, globose or ovoid. *Commelina* has bi-tri locular capsule, 1-5 seeded. *Cyanotis* has 3-valved, capsule, obovoid to oblong and trigonous. *Streptolirion* has 3-valved capsule, ellipsoid and beaked.

Floscopa has 2-valved capsule and slightly flattened. The capsule of *Murdannia* is 3-valved, ovoid, ellipsoid, or globose, and the capsule of *Polliia* is globose, 3-valved and indehiscent. *Rhopalephora*'s capsule is subglobose and 1--3-valved; upper valve 1-seeded, indehiscent, sometimes deciduous; lower valves (when developed) seedless or 1--2 seeded.

Seeds

The seeds are single per locule. The seed surface is rough or ribbed, round or ellipsoid to cylindric. The seeds may be pitted (*Cyanotis*), reticulate (*Murdannia* and *Amischotholype*) and striate (*Floscopa*).

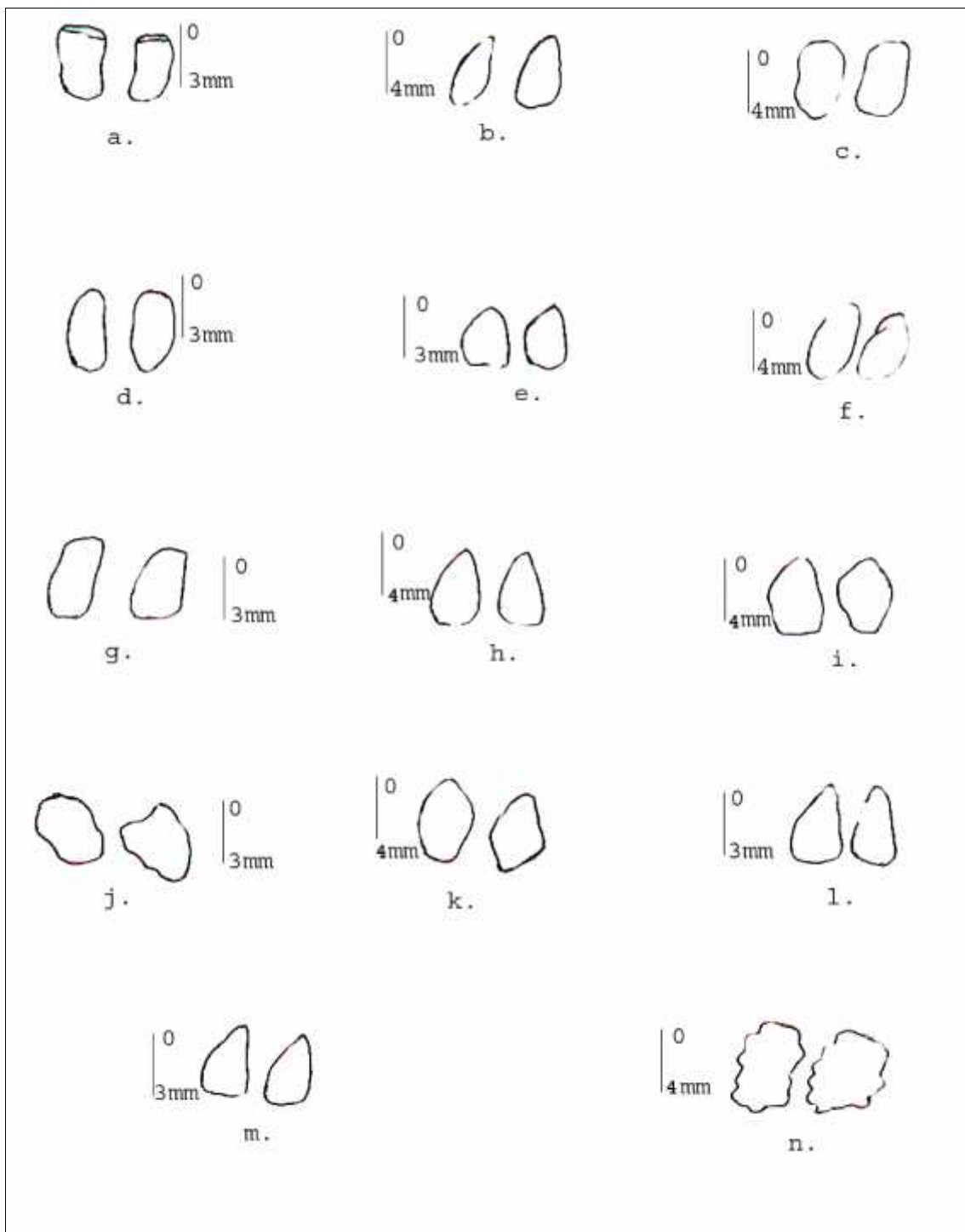


Fig. 6. Variation in Seeds: a. *Cyanotis axillaris* (L.) D. Don ex Sweet, b. *C. vaga* (Lour.) J. A. & J. H. Schult., c. *C. cristata* (L.) D. Don, d. *C. fasciculata* (Hayne ex Roth) Schultes f., e. *Commelina benghalensis* L., f. *C. paludosa* Blume, Enum., g. *C. maculata* Edgew., h. *C. diffusa* N. L. Burman, i. *C. caroliniana* Walter, j. *Murdannia nudiflora* (L.) Brenan., k. *M. spirata* (L.) Bruckn., l. *M. divergens* (C. B. Clarke) Bruc., m. *M. keisak* (Hassk.) Hand.-Mazz., n. *Floscopa scandens* Loureiro.

The *Amischotolype* has 1-2 seeds per valve, cylindric, trigonous, rugose, reticulate and linear hilum.

The seeds of *Commelina* are cylindric or ellipsoid, reticulate or sub smooth, and hilum is linear. The seeds may be smooth, pitted or reticulate (fig. 6).

Cyanotis has 1 -- 2 seeds per valve, cylindric or quadrangular, reticulate or pitted, hilum punctiform. The seeds of *Streptolirion* are 2 per valve, rugose and linear hilum.

Floscopa has 1 seeds per valve, hemispheric, reticulate or striate, and hilum linear.

The seeds of *Murdannia* are 1 or 2 per valve, quadrangular, reticulate, rugose, and hilum orbicular. The seeds may be appendiculate or smooth.

Moreover, the seeds of *Pollia* are 1--8 per valve, polygonal, hilum linear to orbicular, and purplish gray; and the seeds of *Rhopalephora scaberrima* are rugose and hilum linear.

3.2 Taxonomic Treatment

The taxonomic treatment of the genera and species are prepared with necessary illustrations, photographs and keys (bracketed format) wherever necessary. The primary source of information has been derived from the field and the herbarium of the species belonging to the family Commelinaceae. For the species whose specimens are not deposited in herbaria of Nepal, the secondary source of information (literatures from the flora of nearest neighboring countries) has been utilized.

COMMELINACEAE R. Br., Prod. 268, 1810.

Type: *Commelina* Plum. ex. L., Gen. Pl. ed. 5. 25. 1754.

Herbs annual or perennial. *Leaves* alternate, sheaths closed, nodes swollen. *Inflorescence* panicle or coiled cyme or rarely solitary. *Flowers* bisexual, actinomorphic or zygomorphic, bracts modified as spathe. *Sepals* 3, membranous. *Petals* 3, longer, one clawed, and blue (faint, deep) or white or pink. *Stamens* 3-6, basifixed, filaments hairy, staminodes 0-3. *Carpels* 2-3 loculed, ovary superior, style long, axile placentation. *Capsules* 2-3 valved. *Seeds* few, large, hilum linear or orbicular.

About 40 genera and 450 species are found in the world (Deyuan and DeFilipps, 2000). In Nepal, the Commelinaceae are represented by 9 genera and 22 species (Press *et al.*, 2000). However, present study confirms 8 genera and 30 species including 8 new records for Nepal Flora and two doubtful species.

Table 4. Comparative Morphology of the Genera of Commelinaceae in Nepal

S.N.	Genera	Habit	Inflorescence	Flower	Petals	Seeds
1.	<i>Amischatolype</i>	Erect to procumbent, perennial	Terminal	Actinomorphic	Free	Cylindric, reticulate
2.	<i>Commelina</i>	Slender and creeping, annual or perennial	Terminal	Zygomorphic	Free	Cylindric or ellipsoid, reticulate or sub smooth
3.	<i>Cyanotis</i>	Erect or creeping annual or	Terminal or axillary	Actinomorphic	Tubular	Cylindric or quadrangular, reticulate or

		perennial				pitted
4.	<i>Floscopa</i>	Erect, perennial	Broom like	Actinomorphic	Free	Hemispheric, reticulate or striate
5.	<i>Murdannia</i>	Creeping or ascending, annual or perennial	Solitary	Actinomorphic	Free	Quadrangular, reticulate
6.	<i>Polia</i>	Erect and ascending, perennial	Terminal	Actinomorphic	Free	Polygonal
7.	<i>Rhopalephora</i>	Creeping, perennial	Terminal or axillary	Zygomorphic	Free	Elliptic to rectangular, rugose,
8.	<i>Streptolirion</i>	Climber, perennial	Solitary	Actinomorphic	Free	Angular, rugose

Key to Genera of Commelinaceae

- 1.a. Petals fused into a tube, fertile stamens 6 *Cyanotis*
1.b. Petals free, fertile stamens less than 6 2
2.a. Herbs procumbent, inflorescence penetrating leaf sheath, flowers sessile
..... *Amischotolype*
2.b. Herbs erect or climbing or prostrate, inflorescence not penetrating leaf sheath,
flowers pedicellate 3
3.a. Plants climber, involucre bract small *Streptolirion*
3.b. Plants erect or prostrate involucre bract large 4
4.a. Inflorescence broom like, seeds hemispheric *Floscopa*
4.b. Inflorescence axillary or terminal, seeds angular 5
5.a. Flowers zygomorphic, upper petal clawed 6
5.b. Flowers actinomorphic, upper petals simple 7
6.a. Capsule globose to elliptic, seeds reticulate or smooth *Commelina*
6.b. Capsule subglobose, seeds rugose *Rhopalephora*
7.a. Leaves linear, anther sagittate, seeds quadrangular *Murdannia*
7.b. Leaves elliptic, anther rectangular, seeds polygonal *Polia*

1. AMISCHOTOLYPE Hasskarl, Flora. **46**: 391. 1863.

Type: *Forrestia griffithii* C. B. Clarke, Monogr. 236.

Herbs perennial. *Stems* erect to procumbent. *Rhizomes* long. *Leaves* alternate, elliptic adaxially hispid or glabrous, abaxially yellow hirsute, base cuneate, apex caudate-acuminate. *Inflorescences* cymes, pedunculate. *Flowers* actinomorphic. *Sepals* 3, free, carinate, herbaceous. *Petals* 3, free, oblong or obovate-orbicular, purplish. *Stamens* 6, fertile, subequal, filaments torulose villous, anther locules parallel, ovoid, longitudinally dehiscent. *Carpels* 3-loculed ovary, ovules 2 per locule. *Capsule* 3-valved, globose or ovoid. *Seeds* 1-2 per valve, cylindrical, trigonous, rugose, reticulate, hilum linear.

About 20 species are found in the world, in tropical region (Deyuan and DeFilipps, 2000). One species of *Amischotolype* is found in Nepal (Press *et al.*, 2000). Present study confirms the presence of one species; however, there is no herbarium deposited in herbaria of Nepal.

1.1 Amischotolype hookeri (Hasskarl) H. Hara, Fl. Eastern Himal. **1**: 399. 1966. Enum. Fl. Pl. Nep. **1**: 82. 1978. Noltie, Fl. Bhutan **3** (1): 223. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 47. 2000. Deyuan and DeFilipps in Fl. China **24**: 23. 2000.

Type: *Forrestia griffithii* C. B. Clarke, Monogr. 236.

Forrestia hookeri Hassk., Flora. **47**: 629. 1864. (Hook, Fl. Brit. Ind. **6**: 384. 1892)

Herbs perennial, 1--3cm. *Rhizomes* long. *Stems* erect to procumbent. *Leaves* alternate, elliptic, adaxially hispid or glabrous, abaxially yellow hirsute, base cuneate, apex caudate-acuminate. *Inflorescences* cymes. *Sepals* 3, ovate-oblong, subglabrous, persistent. *Petals* 3, pale purple-red. *Stamens* 6, fertile, subequal, anther locules parallel, ovoid, longitudinally dehiscent. *Carpels* 3-loculed ovary, ovules 2 per locule. *Capsules* 3-valved ovoid, conical-tapered at apex. *Seeds* rugose. Fl. Jun--Jul. Fr. Aug--Sept.

Ecology: Evergreen broad-leaved forests.

Distribution: Nepal (E), 200-800 (- 1200) m, E. Himalaya Assam, Indo-China, Burma.

Note: The specimens of this species are not deposited in the herbaria of Nepal. The specimen has been deposited in TI collected by Hara *et al.*(6305473) from Ilam in 1963.10.13. The distribution of the plant has found to be c. 1200m in Eastern Nepal.

2. COMMELINA Plum. Ex. L., Gen. Pl. ed. 5. 25. 1754.

Type: *Commelina communis* L., Sp. Pl. 1: 40-41. 1753.

Herbs annual or perennial. *Roots* thin or tuberous. *Rhizomes* absent. *Stem* slender and creeping below. *Leaves* spiral to alternate, base oblique, lanceolate, acuminate. *Inflorescence* terminal, 1 or cymes enclosed in spathe, upper cyme single flowered, lower cymes several flowered. *Flowers* bisexual and staminate, zygomorphic. *Sepals* 3, membranous. *Petals* 3, longer, one clawed, lower petal is faintly blue. *Stamens* 3-6, basifixed, filaments globose or hairy, staminodes 0-3. *Carpels* 2-3 loculed ovary, superior, style long, axile placentation. *Capsules* bi-tri locular, 1-2 seeded. *Seeds* cylindrical or ellipsoid, reticulate or sub smooth, hilum linear.

About 170 species are found in the world, in tropical and subtropical regions (Deyuan and DeFilipps, 2000). Six species of *Commelina* are found in Nepal (Press *et al.*, 2000).

Present study confirms eight species including two new records.

Table 5: Comparative Morphology of the Species of Commelina in Nepal

S.N.	Genera	Habit	Root	Leaves	Spathe	Capsule	Seeds
1.	<i>Commelina appendiculata</i> C.B. Clarke	Annual	Fibrous	Linear lanceolate	conduplicate	Broadly elliptic	Flattened-ellipsoid with whitish appendage at both ends
2.	<i>Commelina benghalensis</i> L.	Erect or creeping perennial	Fibrous	ovate	Funnel form	Oblong-elliptic. 3-valved	Cylindric or semicylindric, rugose, irregularly reticulate
3.	<i>Commelina caroliniana</i> Walter	Creeping annual	Fibrous	lanceolate	conduplicate	3-locular, 2-valved	Cylindric or quadrangular, reticulate or pitted
4.	<i>Commelina diffusa</i> N. L. Burman	Perennial	Fibrous	Linear lanceolate	conduplicate	Broadly elliptic	Ellipsoid, smooth
5.	<i>Commelina ensifolia</i> R. Br.	Creeping annual	Fibrous	Ovate lanceolate	conduplicate	Oblong, trigonous, 3-valved	Cylindric or ellipsoid, reticulate or sub smooth
6.	<i>Commelina maculata</i> Edgew.	Erect or creeping perennial	Tuberous	Ovate lanceolate	Funnel form	Globose, trigonous, 3-valved	Hemispheric, reticulate or striate
7.	<i>Commelina paludosa</i> Blume	Robust perennial	Thick fibrous	Linear lanceolate	Funnel form	Ovoid-globose, trigonous 3-valved	Quadrangular, reticulate
8.	<i>Commelina suffruticosa</i> Blume	Erect perennial	Tuberous	Ovate lanceolate	conduplicate	globose, 2-valved	Polygonal

Key to the species of Commelina

- 1.a. Spathe funnel form, cincinni larger 2
- 1.b. Spathe conduplicate, cincinni smaller 4
- 2.a. Spathe pubescent, petals smaller 3
- 2.b. Spathe glabrous, petals larger *C. paludosa*
- 3.a. Roots fibrous, cleistogamous flowers present *C. benghalensis*
- 3.b. Roots tuberous, cleistogamous flowers absent *C. maculata*
- 4.a. Leaves linear lanceolate, sheath cylindrical *C. appendiculata*
- 4.b. Leaves ovate to oblong-lanceolate, sheath nearly circular 5
- 5.a. Leaves alternate, petals unclawed 6
- 5.b. Leaves spiral, petals clawed *C. ensifolia*
- 6.a. Inflorescence terminal and axillary, spathe single, tuberous roots absent 7
- 6.b. Inflorescence solitary, spathe in cluster, tuberous roots present *C. suffruticosa*
- 7.a. Capsule 3 valved, antherode with central dark spot on surface, seeds reticulate
..... *C. diffusa*
- 7.b. Capsule 2 valved, antherode with smooth surface, seeds smooth *C. caroliniana*

2.1 Commelina appendiculata C.B. Clarke, Commel. And Crypt. Beng. 13. 1874.
Hook, Fl. Brit. Ind. 6: 374. 1892.

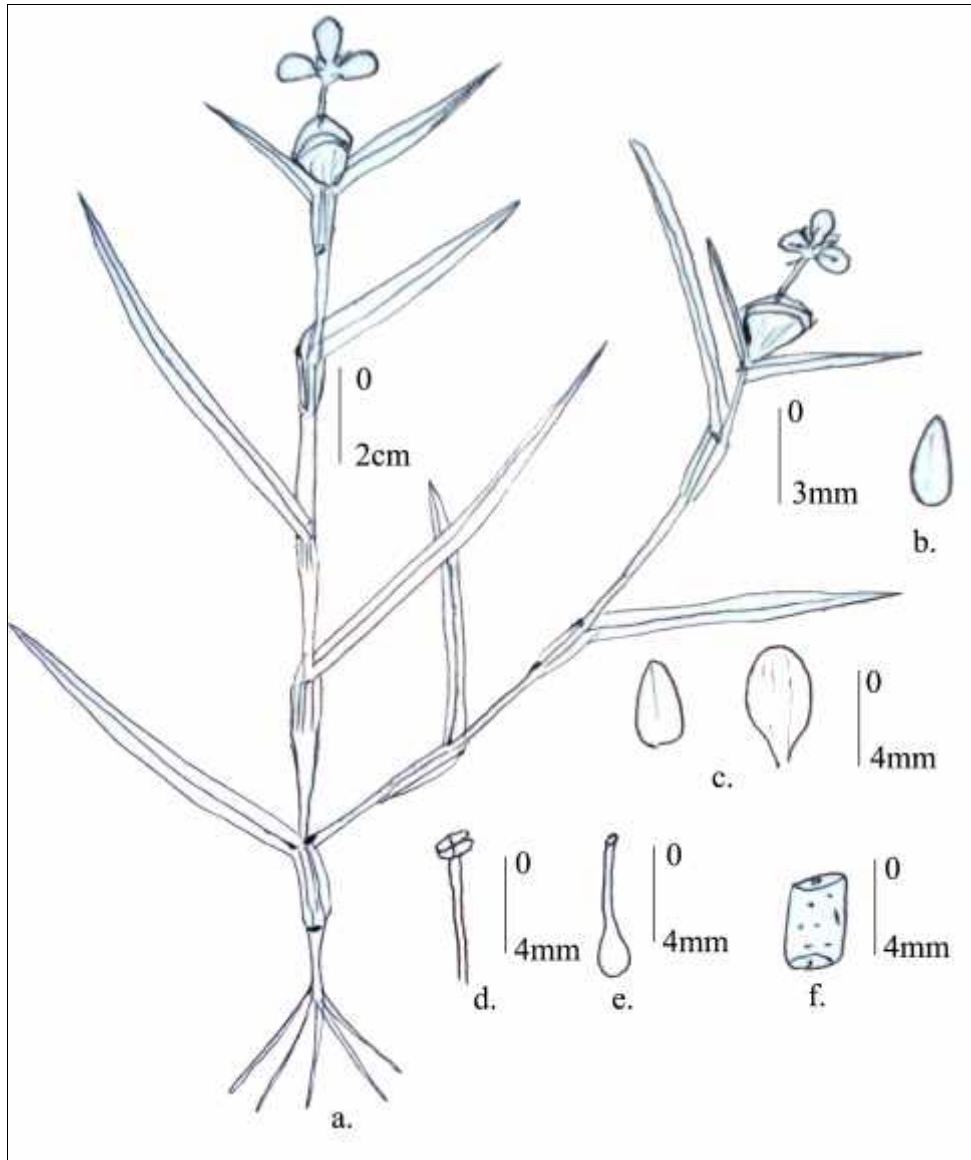
Type: India (Faden, Rev. Handb. Fl. Cey. 4: 189. 2000).

Herbs annual, branched. *Stems* erect. *Leaves* linear-lanceolate, 3--10 X 0.8--1.5 cm, acute, sheaths cylindric. *Inflorescence* terminal or axillary. *Flowers* bisexual, spathe acuminate, conduplicate spathe, cleistogamous flowers absent. *Sepals* 3, 3--4 mm, membranous. *Petals* 3, 3--5 mm, one shortly clawed, lower petal is blue. *Stamens* 6, 4--6 mm, filaments glabrous, staminodes 3, antherode cruciform. *Carpels* 2 locular ovary, 4--6 mm, style long. *Capsules* broadly elliptic, single seed per locule. *Seeds* flattened, smooth, with whitish appendage at both ends. Fl. Jul--Aug. Fr. Oct--Dec. (fig. 7).

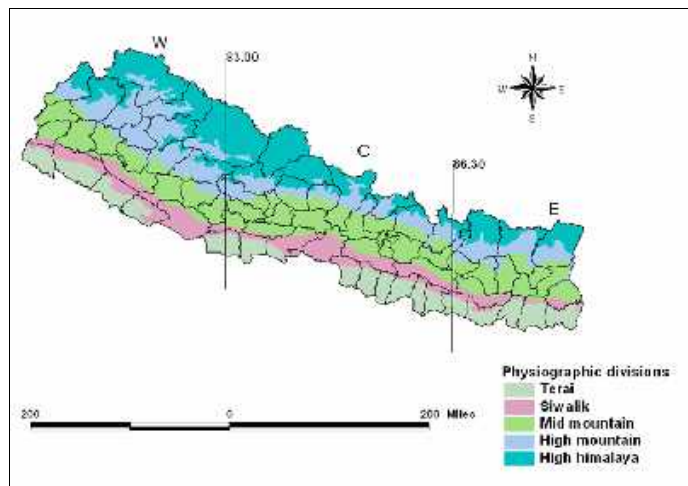
Ecology: Dry place on forest bed.

Distribution: Nepal (C), ca. 1500m, E. and NE India, Eastern Himalaya.

Note: This species is new record for Nepal Flora collected by the author. The species have lanceolate leaves, appendiculata and conduplicate spathe, capsule 2 locular with one seed each and seeds having appendage at both ends. This species closely resembles



A



B

Fig. 7. *Commelina appendiculata* C.B. Clarke; A. Illustration, a. Habit Sketch, b. Sepal, c. Petal, d. Stamens, e. Carpel, f. Seed (J.P. Gajurel 209); B. Distribution map.

the *Commelina benghalensis* on petal morphology. Similarly, the leaves resembles the *Cyanotis vaga*; however, spathe and characters of the seeds help in establishing *C. appendiculata* as a distinct species. It need further study.

Specimens examined

Central Nepal: Kathmandu, Maithan, Sankhu, 1500m, 2006.09.14, J.P. Gajurel, 209 (TUCH, KATH).

2.2 *Commelina benghalensis* L., Sp. Pl. **1**: 41. 1753. Hook, Fl. Brit. Ind. **6**: 370. 1892. Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978. Noltie, Fl. Bhutan **3** (1): 223. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps, Fl. China **24**: 67. 2000.

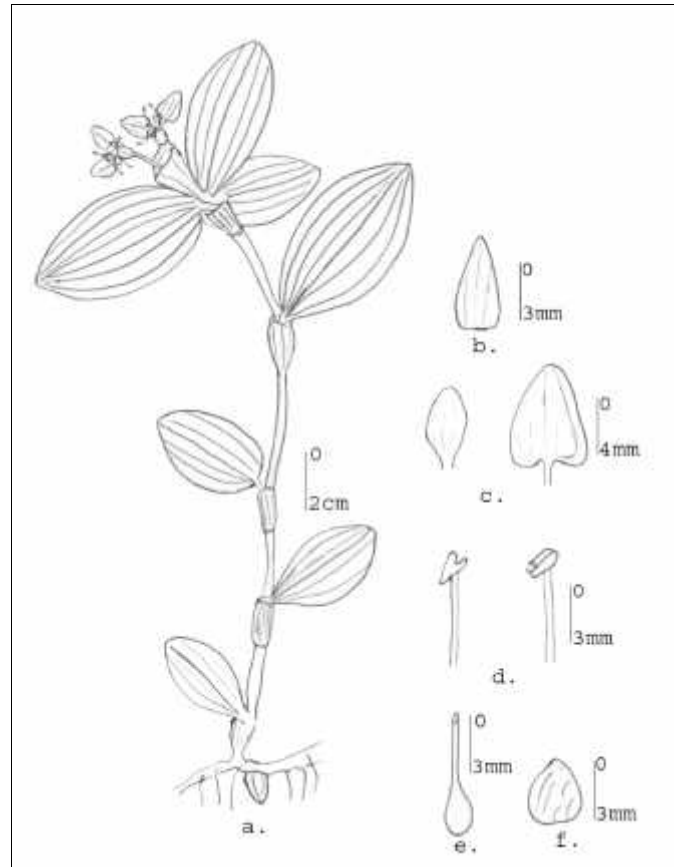
Type: *Commelina cucullata* L., Mant 176. 1771.

Herbs perennial, 20--36 cm. *Stems* slender and creeping below. *Leaves* spirally arranged, 3--6 x 1.5--4 cm, base oblique, ovate, acute, sheath with reddish-brown hairs. *Inflorescence* terminal, 1 or cymes enclosed in funnel shaped spathe, upper cyme staminate, lower cymes several flowered. *Flowers* perfect and staminate, zygomorphic, cleistogamous flowers at base. *Sepals* 3, 3--4 mm, membranous. *Petals* 3, 0.4 --1.2 cm, longer, one clawed, lower petal is faintly blue. *Stamens* 6, 4--6 mm, basifixed, filaments, staminodes 3. *Carpels* 2-3 ovary, 4--6 mm, superior, style long. *Capsules* oblong-elliptic. 3-valved. *Seeds* black, cylindric or semicylindric, rugose, irregularly reticulate. Fl. Jun--Aug. Fr. Aug--Sept. (fig. 8).

Ecology: Common on moist and shady place.

Distribution: Nepal (WCE), (100-) 900-1800 m, Himalaya, India east to China, Japan, Malaysia, Africa.

Note: This species can be easily identified by presence of cleistogamous flower near the ground. There is variation in leaf collected in different places in both size and shape. Some collections have smaller sized leaves and some relatively larger sized leaves. In some collections, the petals have sky blue (slightly light) colour and some collections have deep blue petals. The summit of the sheath in some collections have reddish brown hairs. From the study of the herbarium specimen, the distribution range has been changed and lowest altitude for collection is 100m. The flowering time is usually 6am to 12 pm and flowers fade as sunlight fall on them.



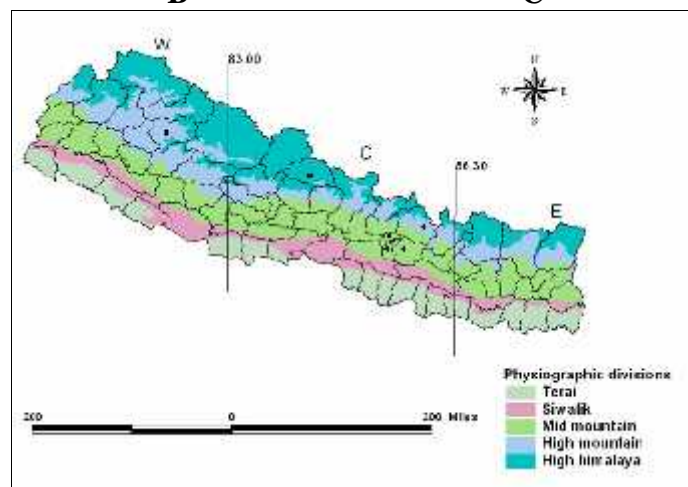
A



B



C



D

Fig. 8. *Commelina benghalensis* L.; A. Illustration: a Habit Sketch, b., Sepal, c. Petal, d. Stamens, e. Carpel, f. Seed; B. Inflorescence; C. Flower; D. Distribution map (J.P. Gajurel 118)

Specimens examined

Western Nepal: Kailali, Seti, 900m, 1978.09.31, Raunior *et al.* 1904 (TUCH, KATH).
Jumla, near bazaar, 800m, 1982.09.12, N.P. Manandhar 9037 (TUCH, KATH).

Central Nepal: Manang, Chame, 1600m, 1983.08.12, N.P. Manandhar 9806 (KATH).
Kathmandu, On the way to Gokarna temple, 1400m, 2006.09.01, J.P. Gajurel 177 (TUCH, KATH). Kirtipur, 1320m, 2006.08.21, J.P. Gajurel 146 (TUCH, KATH). Airport to Tilganga, 1400m, 2006.08.20, J.P. Gajurel 139 (KATH, TUCH). Chovar, 1550m, 2006.08.14, J.P. Gajurel 118 (KATH, TUCH). Dakshinkali entry gate to temple, 1650m, 2006.08.29 J.P. Gajurel 172 (KATH, TUCH). Sundarijal buspark to Barak, 1450m, 2006.08.04, J.P. Gajurel *et al.*, 98 (KATH, TUCH). Budhanilkhanta to Shivapuri, 1900m, 2006.09.01, J.P. Gajurel, 182 (KATH, TUCH). Lalitpur, Godawari to temple area, 1550m, 2006.08.22, J.P. Gajurel 147 (TUCH, KATH). Lamatar-6 to Sisnary, 1600m, 2006.09.07, J.P. Gajurel 200 (TUCH, KATH). Bhaktapur, Kamal Vinayak, 1400m, 2006.08.01, J.P. Gajurel, 90 (KATH, TUCH). Changunarayan, 1600m, 2006.10.13, J.P. Gajurel 257 (TUCH, KATH). Kavre, Dolalghat buspark to picnic spot, 700m, 2006.09.03, J.P. Gajurel 187 (TUCH, KATH). Phulbari-5, 1500m, 2006.08.09, J.P. Gajurel *et al.*, 107 (KATH, TUCH).

Eastern Nepal: Sunsari, Titragachi, 100m, 1993.05.31, P.R. Shakya *et al.* 289 (KATH).

2.3 Commelina caroliniana Walter, Flora Caroliniana, Secundum : 68. 1788. Faden, *Taxon*. **38** (1): 43-53. 1989. Noltie, Fl. Bhutan **3** (1): 237. 2000.

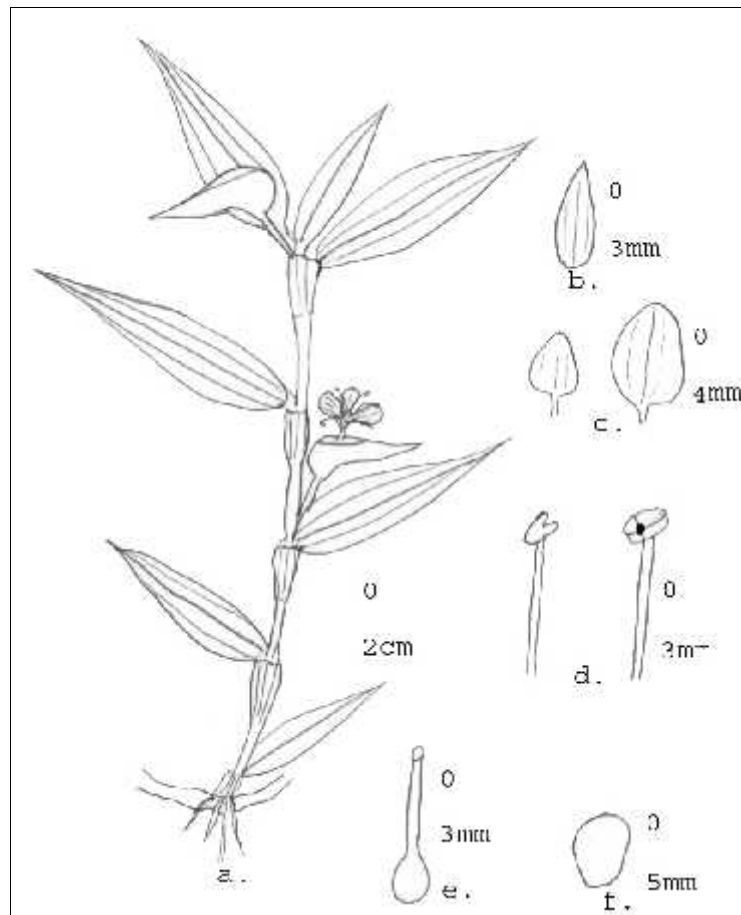
Type: *Commelina caroliniana* Walter, Flora Caroliniana, Secundum : 68. 1788.

Commelina hasskarlii C. B. Clarke, Commel. Cyrt. Bengal.: 13, t. 3. 1874. (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Herbs annual, 20--70 cm. *Stems* diffusely branched, decumbent. *Leaves* alternate, lanceolate, 3.5--7 x 1--1.4 cm, acute to acuminate, glabrous. *Inflorescences* distal cyme, solitary. *Flowers* bisexual. *Sepals* 3, 2--4 mm, free *Petals* 3, 0.4--1 cm, free, two blue, one transparent. *Stamens* 6, 5--7 mm, with white connective, staminodes, antherodes yellow, central spot, cruciform. *Carpels* 3 loculed ovary, 4--7mm, style long. *Capsules* 3-locular, 2-valved. *Seeds* , 1 per valve, dark brown, smooth to faintly alveolate. Fl. Jun--Aug. Fr. Aug--Sept. (fig. 9).

Ecology: On wet field.

Distribution: Nepal (CE), (100-) 700-1400 (-1600) m, Himalaya (Kumaun to Assam), India.



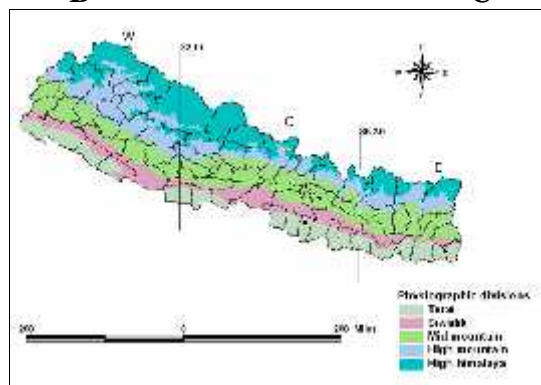
A



B



C



D

Fig. 9. *Commelina caroliniana* Walter; A. Illustration: a Habit Sketch, b., Sepal, c. Petal, d. Stamens, e. Carpel, f. Seed (J.P. Gajurel 206); B. Inflorescence; C. Flower; D. Distribution map.

Notes: The antherodes are with central dark spot. The spot is purple when seen in the fresh plant. In herbarium, the central spot is dark. The plant almost looks like *C. diffusa*, but this character and character of seeds separate this species from *C. diffusa*. This plant is dominant in places with more organic matter. Regarding the distribution, the altitude range from 100-1600m based on collections of the author and the herbarium deposited in herbaria of Nepal.

Specimens examined

Central Nepal: Kathmandu, Kirtipur, Library, 1340m, 2006.09.12, J.P. Gajurel 206 (TUCH, KATH). Champadevi from Tindevi temple, 1550m, 2006.08.16, J.P. Gajurel *et al.* 133 (TUCH, KATH). On the way to Gokarna temple, 1400m, 2006.09.01, J.P. Gajurel 178 (TUCH, KATH). **Kavre**, From Phedi to Namobuddha, 1650m, 2006.10.04, J. P. Gajurel *et al.* 231(TUCH, KATH).

Eastern Nepal: Rauthat, Chandranegahapur, 120m, 2006.10.30, J.P. Gajurel 297 (TUCH, KATH). **Jhapa**, Char-Aali to Army Barak, 100m, 2006.10.26, J.P. Gajurel 280 (TUCH, KATH). Garamuni, 100m, 2006.10.26, J.P. Gajurel 276 (TUCH, KATH).

2.4 Commelina diffusa N. L. Burman, Fl. Indica. 18, pl. 7, fig. 2. 1768. Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps, Fl. China **24**: 36. 2000.

Type: India, Burmann (Rev. Handb. Fl. Cey. **4**: 117-197. 2000).

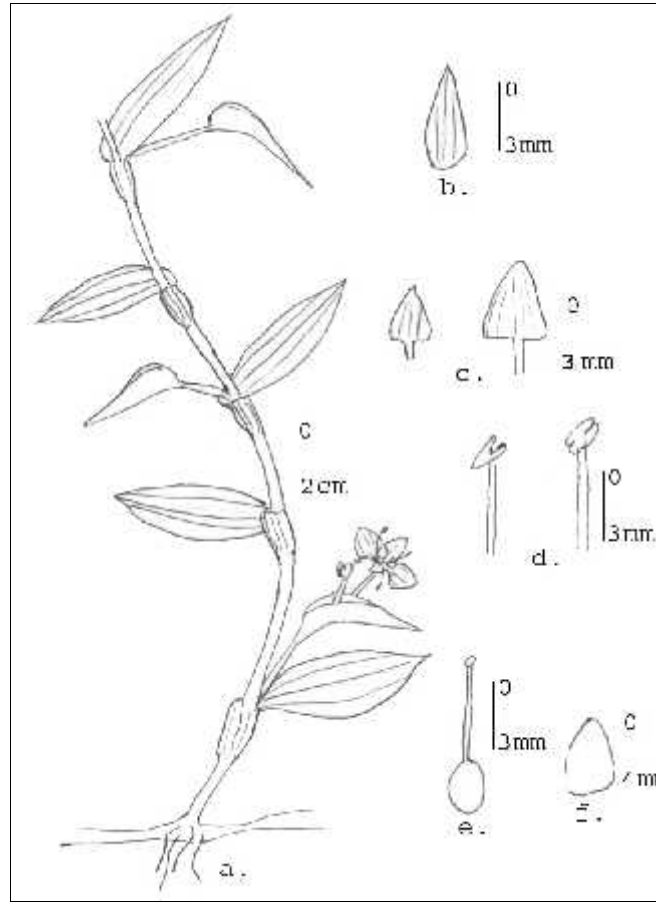
Commelina communis Dalz & Gibs., Bombay Fl. 252. 1861 (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Commelina nudiflora Hook. f., Fl. Brit. India **6**: 369. 1892 (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Commelina salciflora Thw., Enum. Pl. Zeyl. 321. 1864 (Faden, Rev. Handb. Fl. Cey. **4**: 182. 2000).

Herbs annual, 30--40 cm. *Stems* creeping, branched, glabrous. *Leaves* sub sessile, leaf sheath hispid, 3--7.5 x 1--1.5 cm, linear-lanceolate, glabrous, rounded, acuminate. *Inflorescence* terminal, cyme, cincinni branched, pedicels thick, curved, involucre bract lanceolate funnel like. *Flowers* bisexual. *Sepals* 3, 3--4 mm, free, membranous. *Petals* 3, 4--7 mm, blue, concolorous. *Stamens* 6, 4--6 mm, basifixed, staminodes 3. *Carpels* 3 loculed ovary, 4--6 mm, superior, style long. *Capsules* oblong, trigonous, 3-valved. *Seeds* 1 per valve, black, ovoid-globose, reticulate. Fl. May--Nov. Fr. Oct--Sep. (fig. 10).

Ecology: Diffusely spreading in margins of rice fields and wet places.



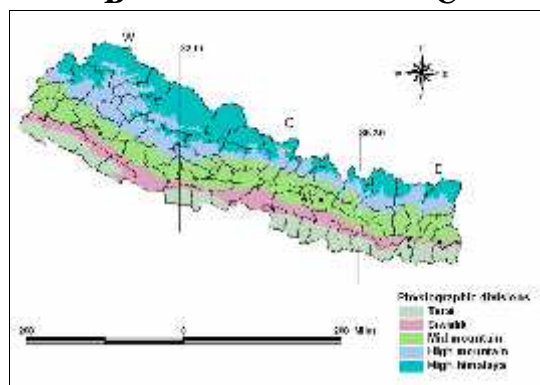
A



B



C



D

Fig. 10. *Commelina diffusa* N. L. Burman; A. Illustration: a Habit Sketch, b., Sepal, c. Petals, d. Stamens, e. Carpel, f. Seed (J.P. Gajurel 286); B. Inflorescence; C. Flower; D. Distribution map.

Distribution: Nepal (CE), (160-) 700-1300 (-1600) m, Pantropic & warm-temperate regions.

Note: This species closely resembles with *C. caroliniana* concerning morphology. However, in *C. diffusa*, the anthers look entirely yellow and there is no dark spot in the anther. The seeds are reticulate. During the study, the distribution of this plant is found to be in altitude range 160-1700m.

Specimens examined

Central Nepal: Lalitpur, Tikabhairab to Chapagaoun, 1550m, 2006.10.07, J. P. Gajurel *et al.* 238 (TUCH, KATH). **Kavre**, Panauti riverside, 1500m, 2006.08.26, J.P. Gajurel 161(TUCH, KATH). **Chitwan**, Ratnanagar Tikauli Jungle, 150m, 2006.10.09, J.P. Gajurel 253 (TUCH, KATH). **Sauraha**, 150m, 2006.10.09, J.P. Gajurel 250 (TUCH, KATH).

Eastern Nepal: Udayapur, Beltar, 160m, 1995.10.21, M. Mikage *et al.* 9552990 (KATH). **Saptari**, Koshi Tappu, 60m, 1995.10.21, M. Mikage *et al.* 9552911 (KATH) **Rauthat**, Chandranegahapur, 120m, 2006.10.30, J.P. Gajurel 296 (TUCH, KATH). **Dharan-2**, Near bus park, 400m, 2006.10.29, J.P. Gajurel 94 (TUCH, KATH). **Ilam**, Ilam bazaar, 1250m, 2006.10.27, J.P. Gajurel 286 (TUCH, KATH).

2.5 Commelina ensifolia R. Br., Prodr. 269. 1810. Hook, Fl. Brit. Ind. **6**: 374. 1892.

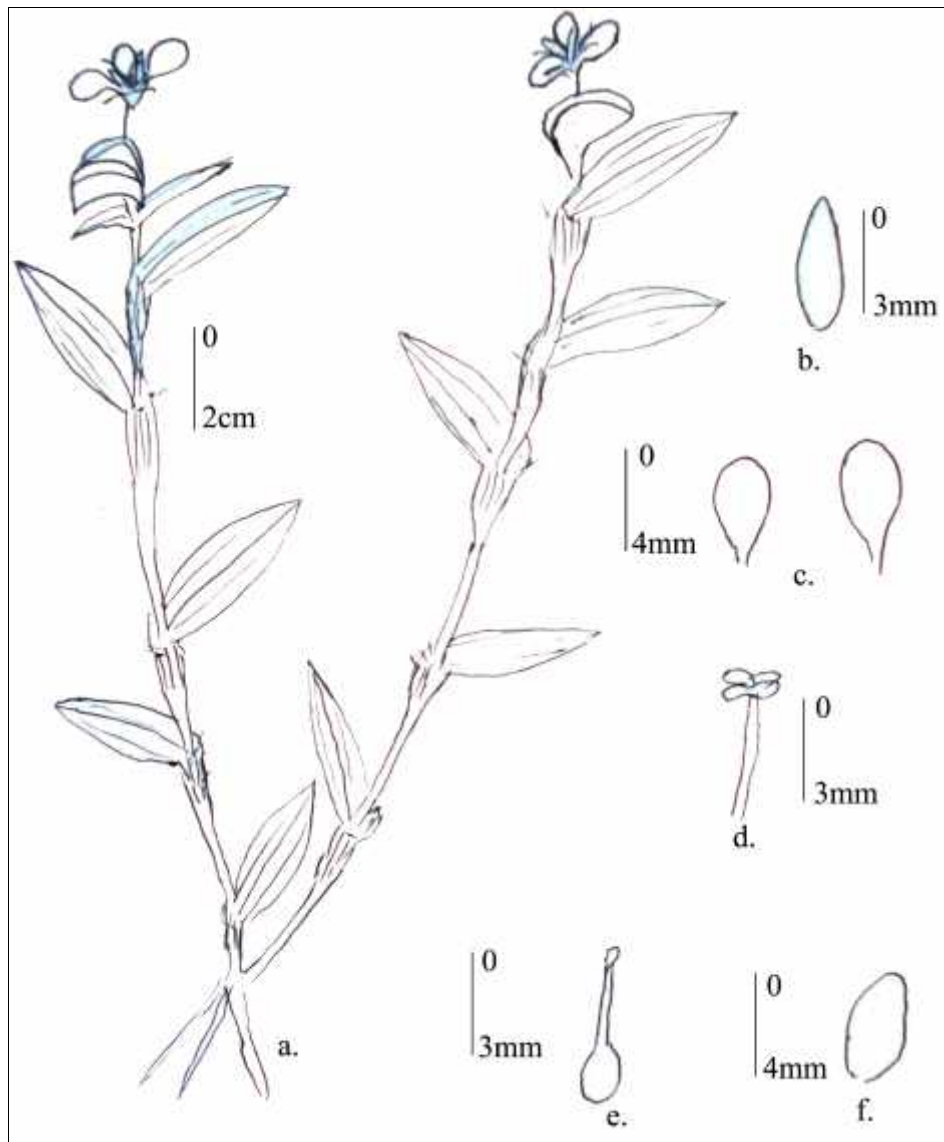
Type: India (Faden, Rev. Handb. Fl. Cey. **4**: 195. 2000).

Herbs perennial, tufted. *Stems* erect. *Leaves* spirally arranged, 2--5 x 1--3 cm, sessile, base connate, ovate-lanceolate, acute, sheaths long. *Inflorescence* terminal or solitary cluster. *Flowers* bisexual and staminate, cleistogamous absent, lower cincinni several flowered. *Sepals* 3, 2--3 mm, membranous. *Petals* 3, 2--4 mm, one shortly clawed, lower petal is faintly blue. *Stamens* 6, 4--5 mm, basifixed, filaments glabrous, staminodes 3, antherode cruciform. *Carpels* 3 locular ovary, 4--5 mm, style long. *Capsules* broadly elliptic, bilocular. *Seeds* ellipsoid, smooth. Fl. Jul--Aug. Fr. Oct--Dec. (fig. 11).

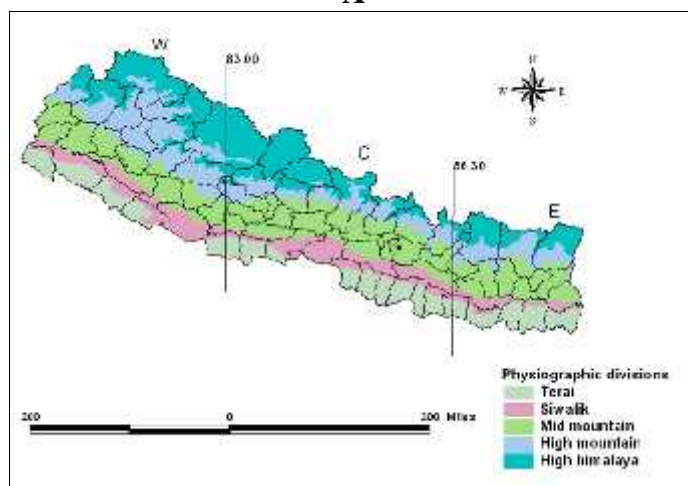
Ecology: It is dominant in partial shade and sandy places, .

Distribution: Nepal (C), ca. 1500m, Peninsular India, Ceylon.

Note: This is new record for Nepal Flora. This newly recorded species closely resembles with *Commelina benghalensis*. However, it differs from the latter in having ovate-lanceolate leaves, comparatively longer sheath, diffused stem, and 3-seeded capsule. Further verification is required.



A



B.

Fig. 11. *Commelina ensifolia* R. Br.; A. Illustration, a. Habit Sketch, b. Sepal, c. Petal, d. Stamens, e. Carpel, f. Seed (J.P. Gajurel 107); B. Distribution map.

Specimens examined

Central Nepal: Kavre, Phulbari-5, 1500m, 2006.08.10, J.P. Gajurel *et al.* 107 (TUCH, KATH).

2.6 *Commelina maculata* Edgew., Trans. Linn. Soc. Lond. **20**: 89 .1846. Hara, Enum. Fl. Pl. Nep. **1**: 82 .1978. Noltie, Fl. Bhutan **3** (1): 225. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48 .2000. Deyuan and DeFilipps, Fl. China **24**: 37 .2000.

Type: *Commelina obliqua* var. *viscida* C.B. Clarke, Commel. Cyrt. Bengal : 19,t. 10. 1874.

Commelina obliqua var. *viscida* C.B. Clarke, Monogr. Phan., **3**: 178. 1881 (Karthikeyan, Fl. Indicae Enum. Monocot. **4**: 25. 1989).

Commelina paludosa var. *viscida* (C. B. Clarke) Rao & Kammathy, Bull. Bot. Surv. India **3**: 168. 1961 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

Herbs perennial, 9--29 cm. *Roots* thin to tuberous. *Stems* creeping proximally, branched, slender, glabrous, sheath sometimes reddish brown. *Leaves* alternate, 3--7.5 x 1--1.7 cm, sheaths brown ciliate at mouth, ovate-lanceolate or lanceolate, oily surface to glabrous. *Inflorescence* terminal cyme, cincinni 2-several flowers, spathe hairy, pedicellate. *Flowers* zygomorphic. *Sepals* 3, 3--5 mm, membranous. *Petals* 3, 0.6--1 cm, blue. *Stamens* 3-6, 4--6 mm, basifixed, filaments hairy, staminodes 0-3. *Carpels* 2-3 loculed ovary, 5--6 mm, superior, style long, *Capsules* globose, trigonous, 3-valved. *Seeds* 1 per valve, gray-black, ellipsoid, flattened, smooth. Fl. Jun--Aug. Fr. Aug--Sept. (fig. 12).

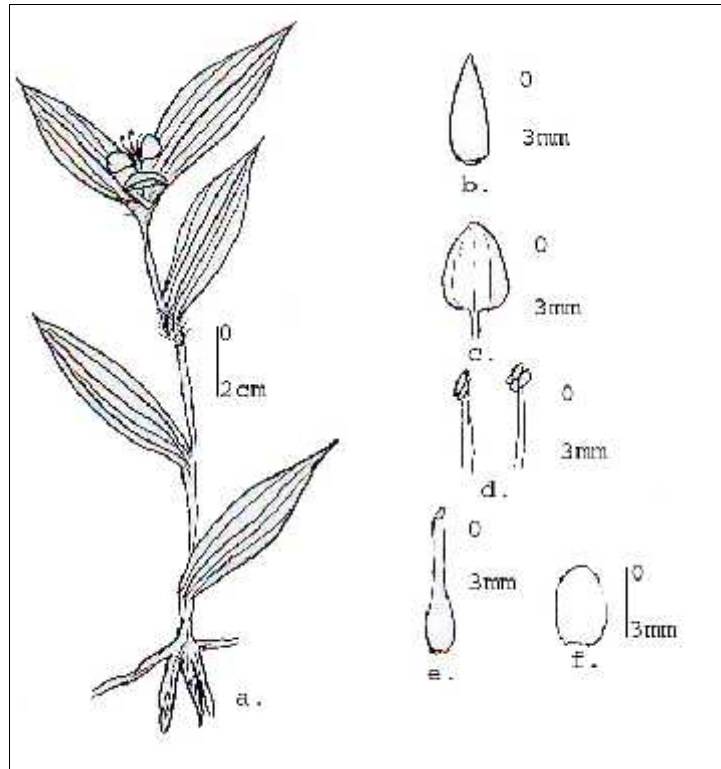
Ecology: Found in moist places.

Distribution: Nepal (CE), (700-) 1600 (-1900)m, Himalaya, India, Ceylon, China, Taiwan, Burma, Malaysia.

Note: The leaves in some collections have oily surface (collections from cold places, on way to Tatopani Custom Office, J.P. Gajurel 270). Anthers with dark centre are seen and seeds are smooth. In some collections, the sheaths have dense brown to reddish brown long hair at the summit, which confuses with *C. paludosa*. There is variation in pubescent. Some are densely pubescent while some are slightly pubescent. However, the hairs are reddish-brown in colour. The range of the altitude found during the study is 700-1900m.

Specimens Examined

Central Nepal: Nuwakot, Ranipauwa, 1900m, 2006.09.02, J.P. Gajurel 185 (TUCH, KATH).

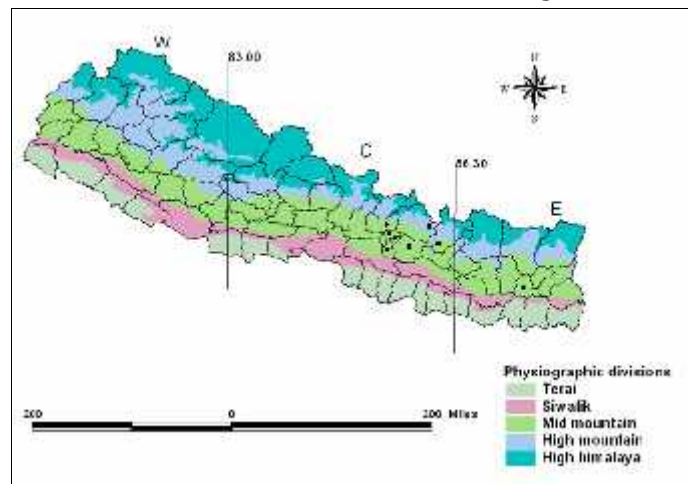


A



B

C



D

Fig. 12. *Commelina maculata* Edgew.; A. Illustration: a Habit Sketch, b., Sepal, c. Petal, d. Stamens, e. Carpel, f. Seed (J.P. Gajurel 156); B. Inflorescence; C. Flower; D. Distribution map.

Kathmandu, On way to Dakshinkali temple, 1600m, 2006.08.02, J.P. Gajurel 94 (TUCH, KATH). Sundarijal buspark to Barak, 1500m, 2006.08.04, J.P. Gajurel *et al.* 102 (TUCH, KATH). Kirtipur Bista gaon to Tindevi temple, 1550m, 2006.08.16, J.P. Gajurel *et al.* 122 (TUCH, KATH). Maithan, Sankhu, 1450m, 2006.09.14, J.P. Gajurel 209 (TUCH, KATH). Bhudhanilkhanta to Shivapuri, 1900m, 2006.11.02, J.P. Gajurel *et al.* 300 (TUCH, KATH). Airport to Tilganga, 1400m, 2006.08.20, J.P. Gajurel 138 (TUCH, KATH). Chovar, 1550m, 2006.08.14, J.P. Gajurel 119 (TUCH, KATH). **Lalitpur**, Godawari to temple area, 1550m, 2006.08.24, J.P. Gajurel 153 (TUCH, KATH). **Lalitpur**, Hatiban, Kirat forest, 1200m, 2006.09.28, J.P. Gajurel 225 (TUCH, KATH). Tikabhairab to Chapagaoun, 1550m, 2006.10.07, J. P. Gajurel *et al.* 240 (TUCH, KATH). Godawari to temple area, 1550m, 2006.08.24, J.P. Gajurel 152 (TUCH, KATH). Chapagaun buspark, 1550m, 2006.09.05, J.P. Gajurel 192 (TUCH, KATH). **Bhaktapur**, Kamal Vinayak, 1400m, 2006.08.01, J.P. Gajurel 85. **Kavre**, Panauti riverside, 1500m, 2006.08.26, J.P. Gajurel 165 (TUCH, KATH). On way to Khopasi powerhouse, 1500m, 2006.09.27, J.P. Gajurel 221 (TUCH, KATH). Phulbari-5, 1500m, 2005.07.26, J.P. Gajurel *et al.* 27 (TUCH, KATH). Dolalghat buspark to picnic spot, 700m, 2006.09.03, J.P. Gajurel 190 (TUCH, KATH). **Sindupalchok**, Tatopani to Custom office, 1400m, 2006.10.20, J.P. Gajurel 270 (TUCH, KATH). Barabise, buspark, 1200m, 2006.10.21, J.P. Gajurel, 272 (TUCH, KATH). **Dolakha**, Charikot to Dolakha Bhimsen, 1500m, 2006.10.15, J. P. Gajurel *et al.* 259 (TUCH, KATH). Charikot to Kalinchok, 1700m, 2006.10.16, J. P. Gajurel *et al.* 263 (TUCH, KATH).

Eastern Nepal: Dhankuta, Near bus park, Hile, 1900m, 2006.10.29, J.P. Gajurel 292 (TUCH, KATH).

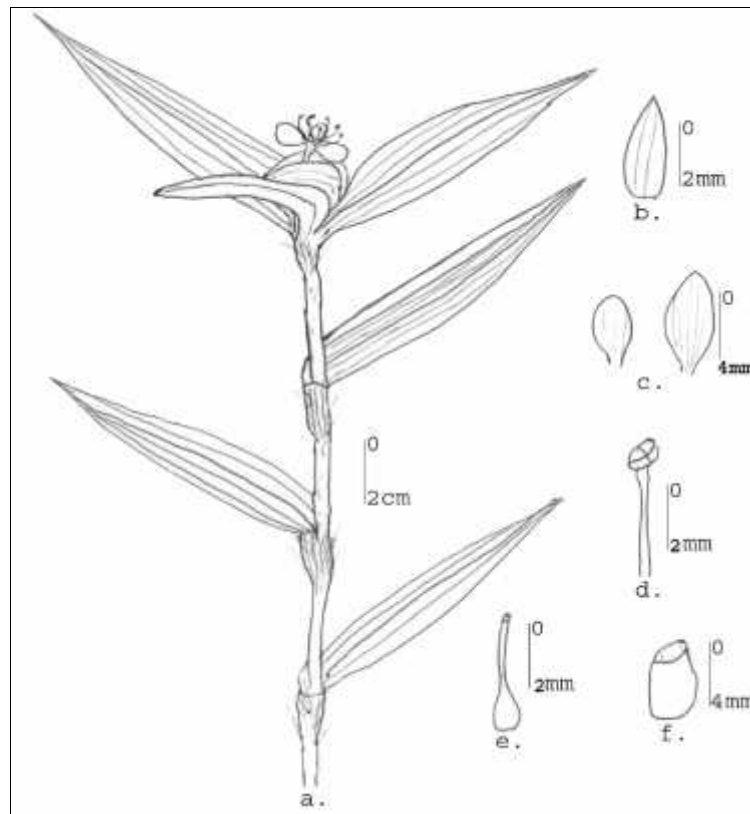
2.7 Commelina paludosa Blume, Enum. Pl. Jav. 1: 2 .1827. Hara, Enum. Fl. Pl. Nep. 1: 82. 1978. Noltie, Fl. Bhutan 3 (1): 235. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps in Fl. China. 24: 37. 2000.

Type : Blume 807, Indonesia: Java (Faden, Rev. Handb. Fl. Cey. 4: 194. 2000).

Commelina donii A. Dietr., Sp. Pl. 6: 2. 359. 1839. (Hara, Enum. Fl. Pl. Nep. 1: 82. 1978).

Commelina obliqua Buch.-Ham. ex D. Don, Prodr. Fl. Nep. 45. 1825. (Hara, Enum. Fl. Pl. Nep. 1: 82. 1978).

Herbs perennial, 45--60 cm, robust. *Stems* erect, branched, glabrous. *Leaves* alternate, 3.5--13.5 x 1--3 cm, sessile sheath dense reddish brown long hairs, lanceolate. *Inflorescence* terminal cyme, cincinnus 1, spathe smooth. *Flowers* bisexual, 1 to several, pedicellate. *Sepals* 3, 2--3 mm, membranous, free. *Petals* 3, 0.3--1 cm, free,



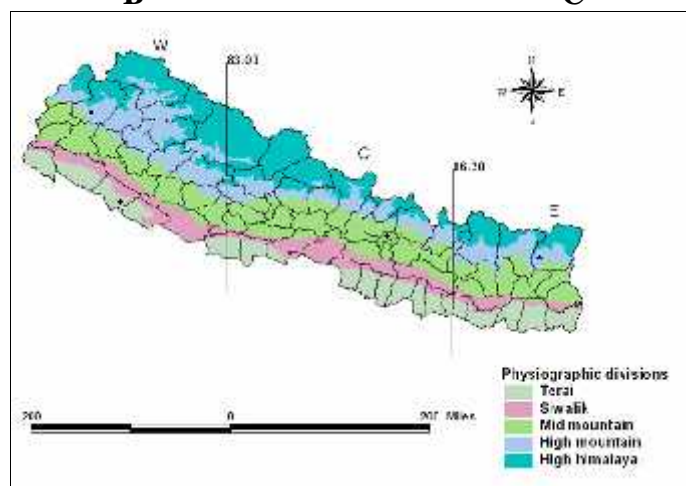
A



B



C



D

Fig. 13. *Commelina paludosa* Blume; A. Illustration: a Habit Sketch, b., Sepal, c. Petals, d. Stamen, e. Carpel, f. Seed (J.P. Gajurel 299); B. Inflorescence; C. Flower; D. Distribution map.

blue, one light blue. *Stamens* 6, 4--6 mm, staminodes 0-3. *Carpels* 3-locular ovary, 4--6 mm. *Capsules* ovoid-globose, trigonous 3-valved. *Seeds* 1 per valve, dark brown, ellipsoid, finely reticulate. Fl. Aug--Sept, Fr. Sept--Oct. (fig. 13).

Ecology: In moist, shady forest margin.

Distribution: Nepal (WCE), (150-) 300-3500 m, Himalaya, India, Ceylon, Indo-China, Taiwan, Burma, Malaysia.

Notes: Plant is robust. The petals are very large. Spathe is funnel form. The sheaths have dense reddish brown long hair at the summit. However, the spathe is glabrous. The lowest altitude found during the study is 150m.

Specimens examined

Western Nepal: Bajhang, bazar, 1200m, 1976.07.28, N.P. Manandhar 26 (KATH). **Bardia**, near national park, 150m, 1992.11.12, Sajani 19 (KATH).

Central Nepal: Kathmandu, Bhudhanilkhanta to Shivapuri, 1900m, 2006.11.02, J.P. Gajurel *et al.* 299 (TUCH, KATH).

Eastern Nepal: Taplejung, Tamur valley, 1100m, 1951.08.03, J.D.A. Stainton 1256 (KATH).

2.8 Commelina suffruticosa Blume, Enum. Pl. Jav. **1**: 3. 1827. Hook, Fl. Brit. Ind. **6**: 374. 1892. Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978. Noltie, Fl. Bhutan **3** (1): 236. 2000. Press *et al.* in Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps in Fl. China **24**: 36. 2000.

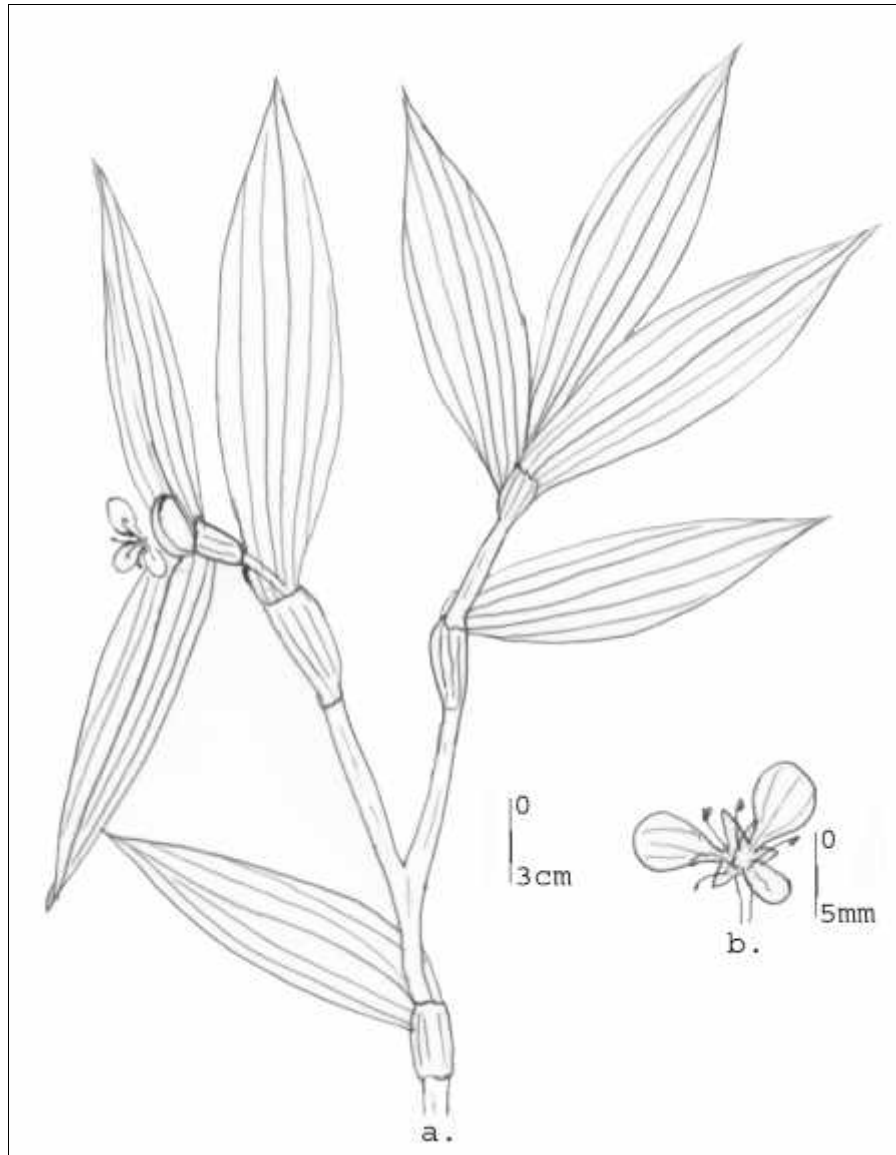
Type: *Spathodithyros suffruticosus* (Blume) Hassk. Comm. Ind. 11. 1870.

Spathodithyros suffruticosus (Blume) Hassk., Comm. Ind. 11. 1870 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

Herbs perennial, 20--36cm. *Roots* tuberous. *Stems* erect, branched, glabrous. *Leaves* alternate, 3.5--13.5 x 1--3 cm, sheaths ciliate, lanceolate to ovate-lanceolate, glabrous. *Inflorescence* terminal cyme, cincinni 4-flowered, pedicellate, involucre bract obtuse at apex. *Flowers* bisexual. *Sepals* 3, 3--5 mm, membranous. *Petals* 3, 4--6 mm, purple. *Stamens* 6, 3 staminodes. *Carpels* 3-locular ovary. *Capsules* globose, 2-valved. *Seeds* 1 per valve, light brown, ellipsoid, rugose. Fl. Aug--Sept. Fr. Sept--Oct. (Fig. 14).

Ecology: Dominant in side of forest.

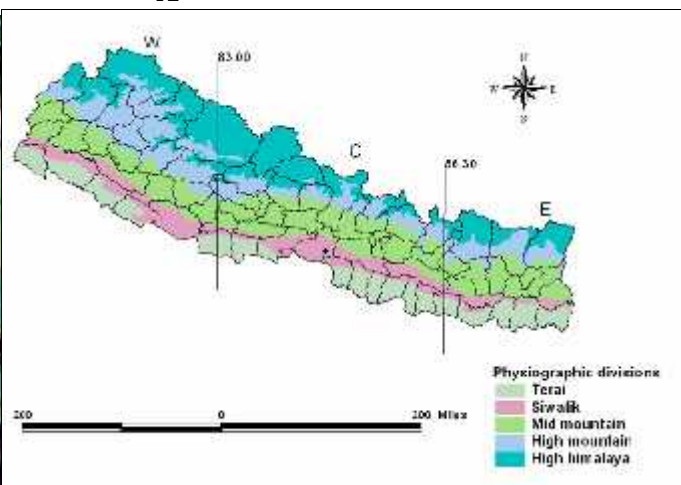
Distribution: Nepal (C), 150m, Himalaya, India, Malaysia.



A



B



C

Fig. 14. *Commelina suffruticosa* Blume; A. Illustration: a Habit Sketch, b. Flower (J.P. Gajurel 252); B. Inflorescence; C. Distribution map.

Notes: The leaves are relatively larger. The spathes are densely clustered and pubescent. Similarly, the tuberous roots are also present in some specimens.

Specimen examined:

Central Nepal: Chitwan, Ratnanagar, Tikauli Jungle, 150m, 2006.10.09, J.P. Gajurel, 252 (TUCH, KATH).

3. CYANOTIS D. Don, Prodr. Fl. Nepal. 45. 1825.

Type: *Cyanotis barbata* D. Don., Prodr. Fl. Nepal. 45. 1825.

Herbs annual or perennial, erect or creeping. *Rhizomes* absent. *Leaves* spiral, sessile, succulent. *Inflorescence* terminal or axillary, cyme, cincinni sessile, bracteoles persistent. *Flowers* bisexual, actinomorphic. *Sepals* 3, free, sepaline. *Petals* 3, connate, tubular, linear-lanceolate, blue to violet or mauve. *Stamens* 6, fertile, equal, filaments sub apical swelling, anther locules longitudinally dehiscent. *Carpels* 3-loculed ovary, ovules 2 per locule. *Capsules* 3-valved, obovoid to oblong, trigonous. *Seeds* 1-- 2 per valve, cylindrical or quadrangular, reticulate or pitted, hilum punctiform.

About 50 species are found in the world, in tropical and subtropical regions (Deyuan and DeFilipps, 2000). Four species of *Cyanotis* are found in Nepal (Press *et al.*, 2000). Present study confirms 6 species of *Cyanotis* in Nepal including 3 new records for Nepal Flora.

Table 6: Comparative Morphology of Species of Cyanotis in Nepal

S. N.	Genera	Habit	Leaves	Inflorescence	Filament	Capsule	Seeds
1.	<i>Cyanotis arachnoidea</i> C.B. Clarke	Perennial	Linear lanceolate	Terminal or axillary	Sub apical swelling present	Obovoid, trigonus	Pitted
2.	<i>Cyanotis axillaris</i> (L.) D. Don ex Sweet	Perennial	Linear, acuminate	Axillary,	Sub apical swelling present	Capsule 3-valved, oblong, compressed	Pitted
3.	<i>Cyanotis cristata</i> (L.) D. Don	Perennial	Oblong-lanceolate, lanceolate-elliptic	Terminal, axillary,	Sub apical swelling present	2-3 valved, columnar, trigonous	Ovate, pitted
4.	<i>Cyanotis fasciculata</i> (Hayne ex Roth) Schultes f.	Perennial	Linear to lanceolate, sessile, acute or	Axillary and terminal	No swelling below tip	Oblong, trigonus	Oblong, rugose

			acuminate				
5.	<i>Cyanotis thwaitesii</i> Hassk.	Annual	Linear lanceolate	Axillary	Sub apical swelling present	Oblong	Pitted
6.	<i>Cyanotis vaga</i> (Lour.) J. A. & J. H. Schult.	Annual	linear, lanceolate,	Solitary or axillary,	Sub apical swelling present	3-valved, obovoid, trigonus	Retic ulate

Key to Species of Cyanotis

- 1.a. Plants cottony, leaves narrower 2
1.b. Plants villous to glabrous, leaves broader 3
2.a. Roots bulbous, with swelling below the tip on stamen *C. thwaitesii*
2.b. Roots fibrous, without swelling below the tip on stamen *C. fasciculata*
3.a. Main stem undeveloped, leaves basal rosette *C. arachnoidea*
3.b. Main stem developed, leaves spiral 4
4.a. Cymes enclosed in bracteoles, cincinni large *Cyanotis axillaris*
4.b. Cymes enclosed in leaf sheaths, cincinni small5
5.a. Leaves oblong lanceolate, bracts foliaceous, seeds pitted *C. cristata*
5.b. Leaves linear lanceolate, bracts smaller, seeds reticulate *C. vaga*

3.1 Cyanotis arachnoidea C.B. Clarke, in A. De Candolle and C. De Candolle, Monogr. Phan. 3 : 250. 1881. Hook, Fl. Brit. Ind. 6: 386. 1892.

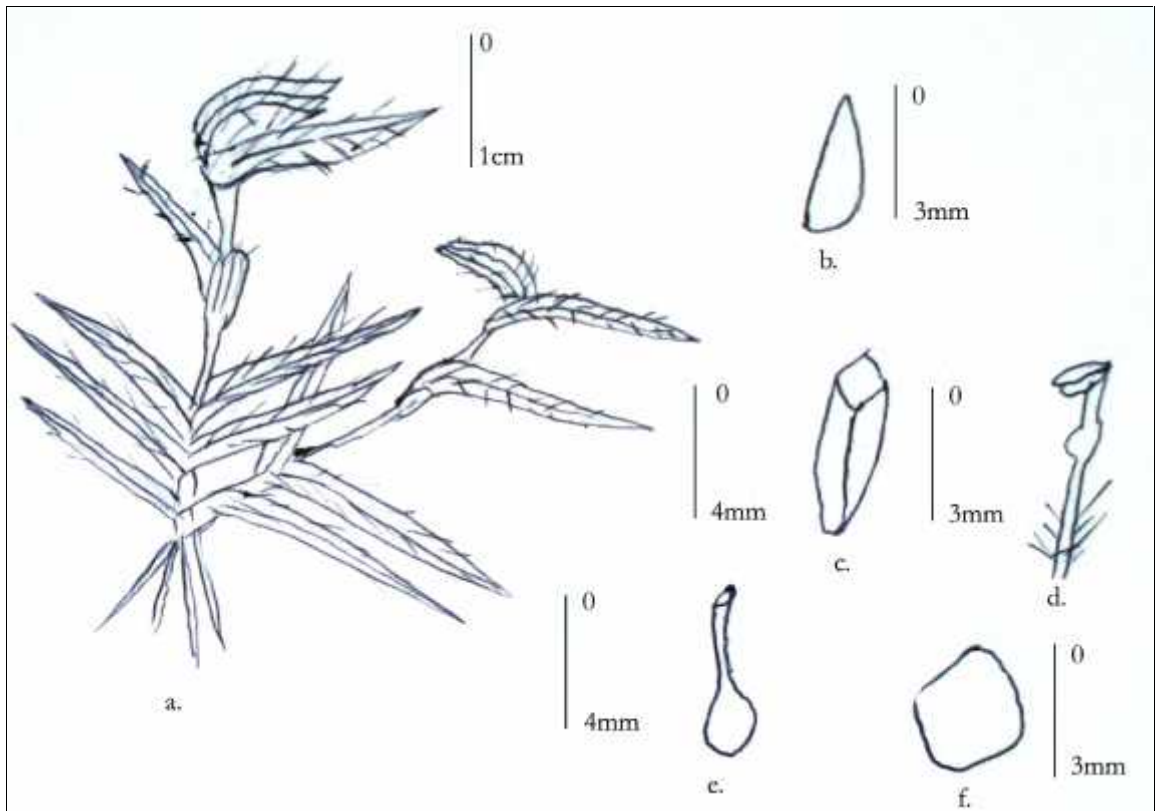
Type: Peninsular India (Karthikeyan, Fl. Indicae Enum. Monocot. 4: 26. 1989).

Herbs perennial. Roots fibrous. *Stems* short, undeveloped. Leaves spiral, 0.5--3 x 0.3--0.5 cm, basal rosette, cauline, linear, lanceolate, densely pubescent. *Inflorescence* terminal or axillary, cincinni solitary, sessile. *Flowers* bisexual. *Sepals* 3, 3--4 mm, linear-lanceolate, connate at base. *Petals* 3, 4--5 mm, tubular, blue. *Stamens* 6, 5--6 mm, fertile, equal, filaments sub apical swelling, hairy at base. *Carpels* 3-loculed ovary, 5--6 mm, ovules 2 per locule. *Capsules* obovoid, trigonus. *Seeds* 1--2 per valve, pitted. Fl. Aug--Sept. Fl. Oct--Dec. (fig. 15).

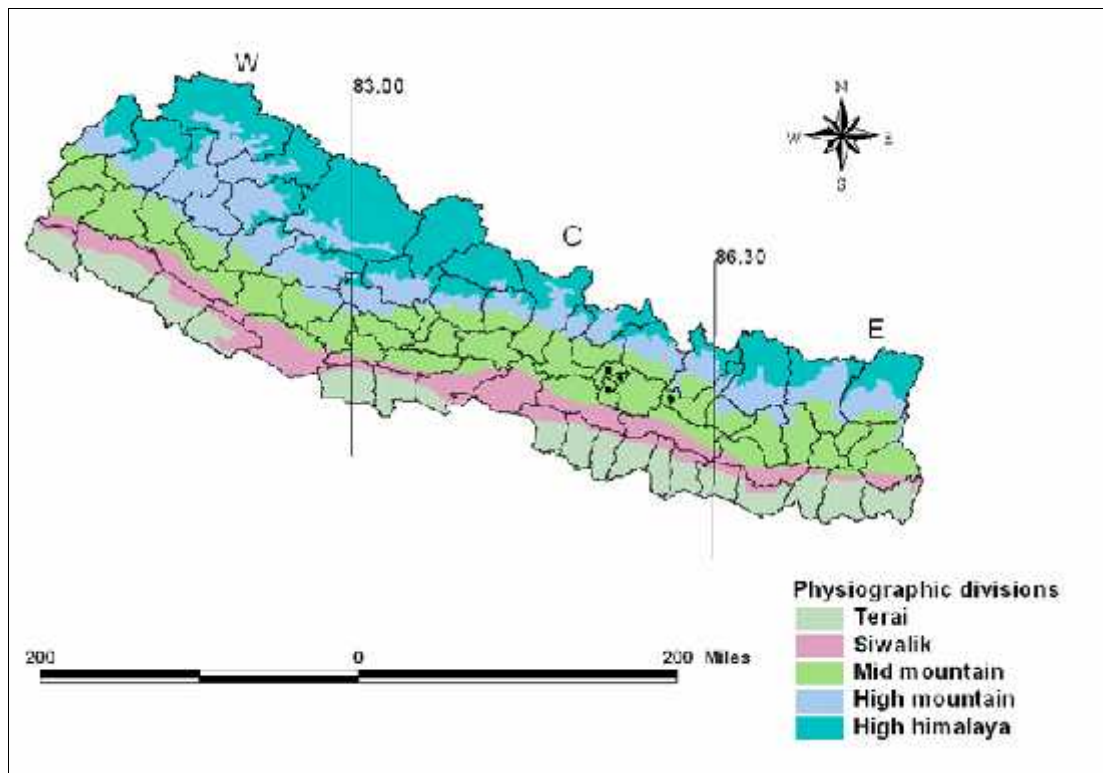
Ecology: On grassland.

Distribution: Nepal (C), ca. 1700m, Peninsular India, China.

Note: This species is new record for Nepal Flora. The species closely resemble with *C. vaga*. However, from the collections of the author, it is quite distinct. The species has short undeveloped stem and leaves along with bracts, which are densely pubescent.



A



B

Fig. 15. *Cyanotis arachnoidea* C.B. Clarke; A. Illustration, a. Habit Sketch, b. Sepal, c. Petal, d. Stamens, e. Carpel, f. Seed (J.P. Gajurel 264); B. Distribution map.

Specimens examined

Central Nepal: Dolakha, Charikot to Kalinchok, 1700m, 2006.10.16, J.P. Gajurel *et al.* 264 (TUCH, KATH).

3.2 Cyanotis axillaris (L.) D. Don ex Sweet, Hort. Brit. 430. 1826. Hook, Fl. Brit. Ind. **6**: 388. 1892. Noltie, Fl. Bhutan **3** (1): 222. 2000. Deyuan and DeFilipps in Fl. Ch. **24**: 23. 2000.

Type: *Commelina axillaris* L. Sp. Pl. **1**: 42. 1753.

Amischophacelus axillaris (L.) Rao & Kammathy J. Linn. Soc. Bot. **59**: 306. 1966 (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Tradescantia axillaries(L.) L., Mant. **2**: 321. 1771 (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Zygomenes axillaris L., Salisbury in Trans. Hort. Soc. **1**: 271. 1812 (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Herbs annual, 9--16cm. *Roots* fibrous. *Stems* erect or creeping, branched. *Leaves* spiral, 2--4 x 0.4--0.6 cm, cauline, linear, glabrous, acuminate, sheath ciliate. *Inflorescence* axillary, cyme, cincinni reduced. *Flowers* 3--6, bisexual, bracteoles present. *Sepals* 3, 6--9 mm, free, linear-spathulate. *Petals* 3, 8--12 mm, long-clawed, blue. *Stamens* 6, fertile, filaments sub apical swelling, lanate, blue. *Carpels* 3-loculed ovary, style ovoid below tip, glabrous *Capsules* 3-valved, oblong, compressed, glabrous trigonous. *Seeds* 1 per valve, pits swallow. Fl. Sept--Oct. Fr. Oct--Nov. (fig. 16).

Ecology: On wet places.

Distribution: Nepal (WCE), 200- (1200-2100) m, Himalaya, India to China, Malaysia, Australia.

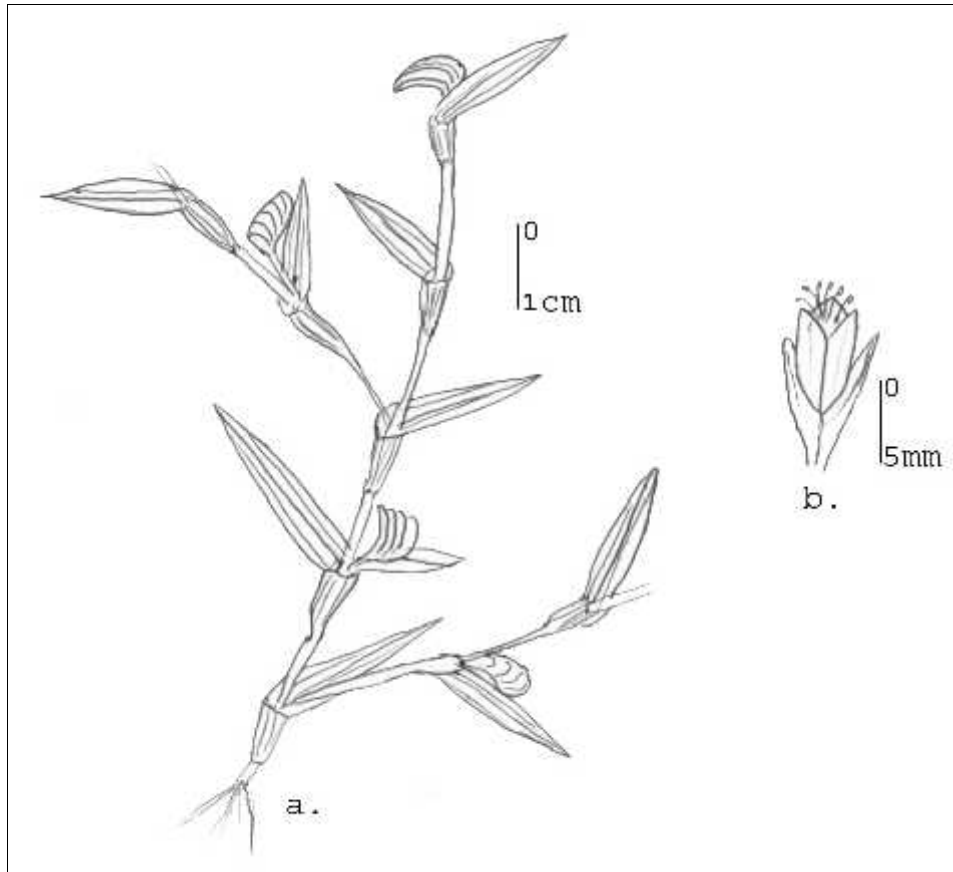
Notes: It inflorescence enclosed within the leaf sheaths and its beaked and stipitate capsule makes it distinctive. The this specimens have been collected by different people in altitude range 1200-2100m. However, there is no specimens showing elevation less than 1200m.

Specimens examined

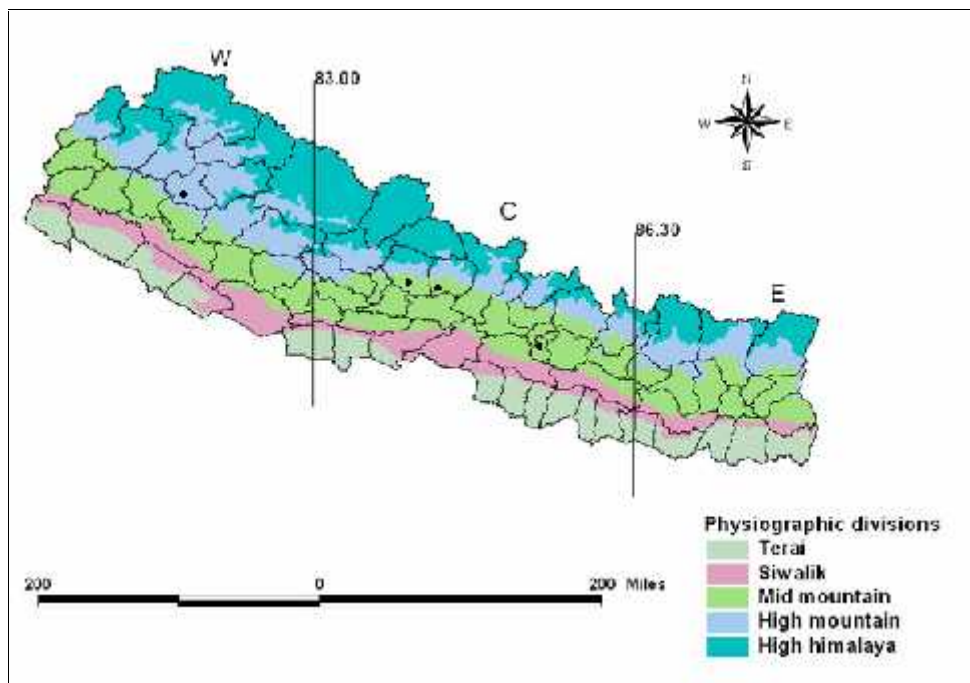
Western Nepal: Kalikot, near buspark, 1600m, 1981.08.14, N.P. Manandhar *et al.* 8269 (KATH).

Central Nepal: Kaski, Ghandruk, 2100m, 1986.06.29, N.P. Manandhar 1106 (KATH).

Lamjung, 1350m, 1983.08.10, N.P. Manandhar 9582 (KATH). **Lalitpur**, Lele, 1540m, 1989.10.04, N. Pradhan *et al.* 36 (KATH).



A



B

Fig. 16. *Cyanotis axillaris* (L.) D. Don ex Sweet; A. Illustration: a. Habit Sketch, b. Flower (N.P. Manandhar 1106); B. Distribution map

Eastern Nepal: Ilam, Ilam, 1200m, 1963.10.13, Hara *et al.* 6307422 (KATH).

3.3 Cyanotis cristata (L.) D. Don, Prodr. Fl. Nepal.: 46. 1825. Hook, Fl. Brit. Ind. **6**: 385. 1892. Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978. Noltie, Fl. Bhutan **3** (1): 221. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps in Fl. China **24**: 22. 2000.

Type: *Commelina cristata* L., Fl. Zeyl. 13. 1747.

Tradescantia cristata L. , Sp. Pl. 42. 1753 (Karthikeyan, Fl. Indicae Enum. Monocot. **4**: 26. 1989).

Herbs annual, 25--35 cm. *Roots* fibrous. *Stems* creeping, often branched. *Leaves* spiral, 1--9 x 1--2 cm, cauline, oblong-lanceolate to lanceolate-elliptic, margin ciliate, glabrous. *Inflorescence* terminal, axillary, cyme, bracts foliaceous, bracteoles falcate, cincinni solitary or terminal. *Flowers* bisexual, actinomorphic. *Sepals* 3, 2--3mm, connate, linear-oblong to oblanceolate. *Petals* 3, 3--4 mm, blue or purple. *Stamens* 6, 5--7 mm, fertile, filaments blue, sub apical swelling. *Carpels* hairy at base, 4--6 mm, stigma capitate. *Capsules* 2--3 valved, columnar, trigonous. *Seeds* 2 per valve, ovate, pitted. Fl. Jul--Aug. Fr. Sep--Oct. (fig. 17).

Ecology: Usually in moist places, roadside ditch, under tress and shrubs.

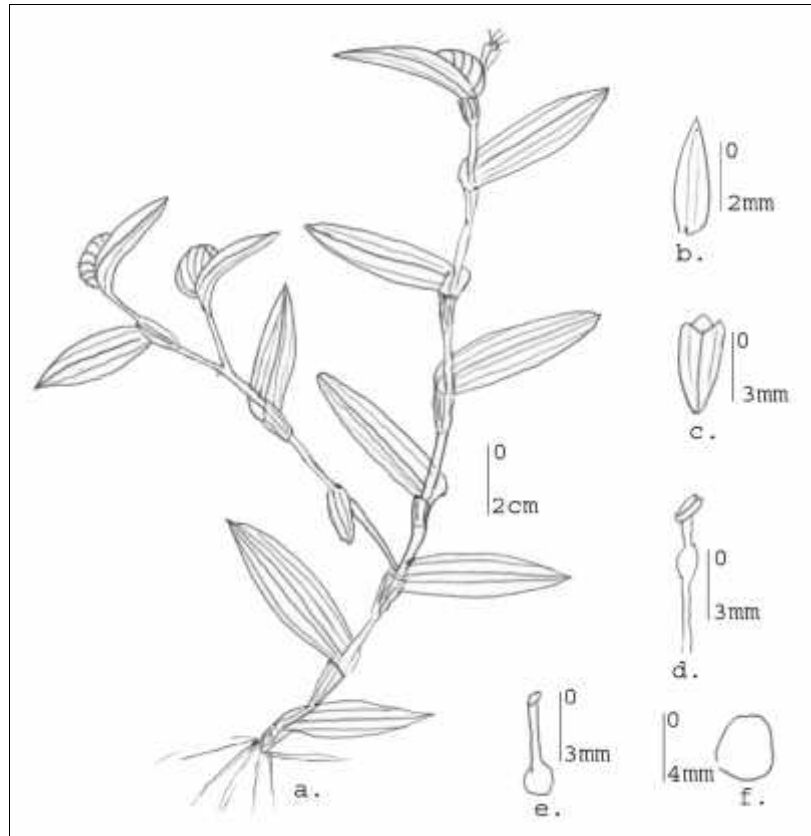
Distribution: Nepal (WCE), (100-) 200 – 1200 (1400) m, Himalaya, India, China, Malaysia, Tropical Africa.

Notes: The plant looks like *Commelina* but differs in having narrow succulent leaves and tubular corolla. The bracts are much longer than the inflorescence and it is foliaceous. One species collected from the Dolalghat (J.P. Gajurel 189) have leaves broad, glabrous and erect. The specimen is different from those specimens deposited at KATH. Similarly, one specimen (J.P. Gajurel 285) from Ilam, has reddish stem, different from other specimens. There is altitudinal variation on which species occur, i.e. 100-1400m found during the study. During the study, the herbarium was found representing Western Nepal.

Specimens examined

Western Nepal: Kailali, Seti, 1200m, 1978.09.31, Rauniyar 1904 (KATH).

Central Nepal: Kavre, Dolalghat buspark to picnic spot, 700m, 2006.09.03, J.P. Gajurel 189 (TUCH, KATH).



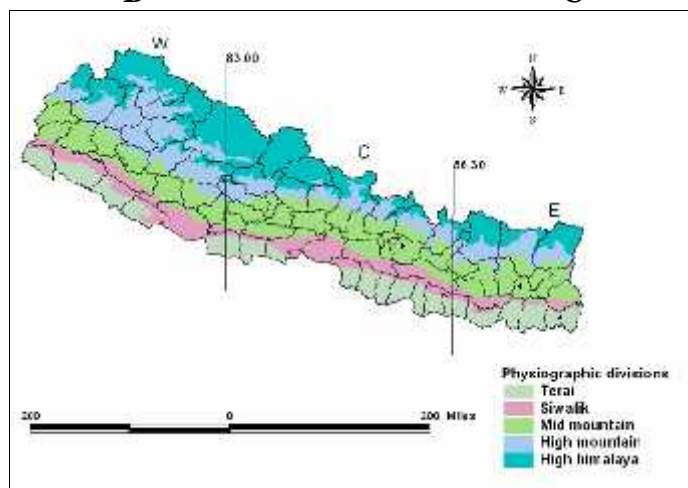
A



B



C



D

Fig. 17. *Cyanotis cristata* (L.) D. Don; A. Illustration: a. Habit Sketch, b., Sepal, c. Petals, d. Stamen, e. Carpel, f. Seed (J.P. Gajurel 277); B. Inflorescence; C. Flower; D. Distribution map.

Eastern Nepal: Dhankuta, Near bus park, 1400m, 2006.10.28, J.P. Gajurel 291 (TUCH, KATH). **Jhapa**, Char-Aali to Army Barak, 100m, 2006.10.26, J.P. Gajurel 277 (TUCH, KATH). **Ilam**, Campus to football ground Ilam, 1200m, 2006.10.27, J.P. Gajurel 285 (TUCH, KATH).

3.4 Cyanotis fasciculata (Hayne ex Roth) Schultes f., Syst. VII 1152. 1830. Hook, Fl. Brit. Ind. 6: 387. 1892. Noltie, Bhutan 3 (1): 222. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000.

Type: *Cyanotis fasciculata* (Hayne ex Roth) Schultes f. Syst. VII 1152. 1830.

Herbs annual, 20--25cm, silky, decumbent. *Stems* branched, pubescent (wooly white hairs). *Leaves* spiral, 3--6 x 0.5--1 cm, linear to lanceolate, sessile, acute or acuminate, straight or recurved, densely pubescent (wooly white hairs). *Inflorescence* axillary and terminal, cyme, cincinni 2 to many flowered. *Flowers* bisexual, bracteoles falcate, acuminate. *Sepals* 3, 2--6 mm, ovate lanceolate, acuminate. *Petals* 3, 3--5 mm, lobes ovate, obtuse, blue. *Stamens* 6, 4--6 mm, fertile, pubescent at base, filaments not swelling below tip. *Carpels* 3 loculed ovary, 4--6 mm, style naked. *Capsules* oblong, trigonous. *Seeds* oblong, rugose. Fl. Aug--Sep. Fr. Sept--Oct. (fig. 18).

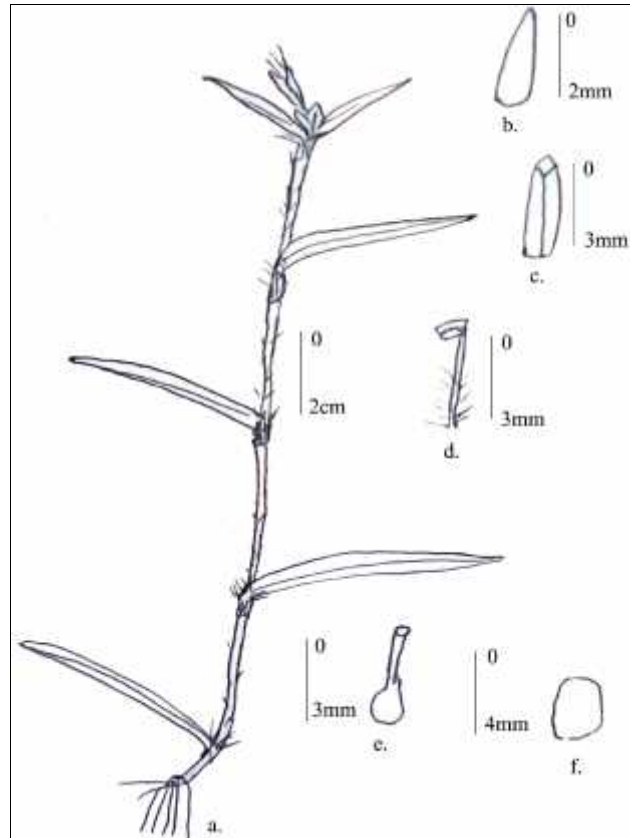
Ecology: Rocky moist surface.

Distribution: Nepal (CE), 1200-1900 m, India.

Notes: The plant is characterized by silky white hairs and linear smaller leaves. The bracteoles are also hairy. The flowers are small and deep blue. The flowering time is 7am to 1pm. One specimen collected from Shivapuri (J. P. Gajurel *et al.* 301) had no woolly bracts.

Specimens examined

Central Nepal: Kathmandu, Dakshinkali entry gate to temple, 1650m, 2006.08.29, J.P. Gajurel 168 (TUCH, KATH). Bhudhanilkhanta to Shivapuri, 1900m, 2006.11.02, J. P. Gajurel *et al.* 301 (TUCH, KATH). Maithan, Sankhu, 1450m, 2006.09.14, J.P. Gajurel 207 (TUCH, KATH). **Lalitpur**, Tikabhairab to Chapagaoun, 1550m, 2006.10.07, J. P. Gajurel *et al.* 243 (TUCH, KATH). On the way to Phulchoki, 1700m, 2006.09.16, J.P. Gajurel 218 (TUCH, KATH). Lamatar-6 to Sisnary, 1600m, 2006.09.07, J.P. Gajurel 198 (TUCH, KATH). **Kavre**, Phulbari-5, 1500m, 2006.08.09, J. P. Gajurel *et al.* 109 (TUCH, KATH). On way to Khopasi powerhouse, 1500m, 2006.09.27, J.P. Gajurel 219 (TUCH, KATH). **Dolakha**. Charikot to buspark, 1600m, 2006.10.17, J. P. Gajurel *et al.* 266 (TUCH, KATH).

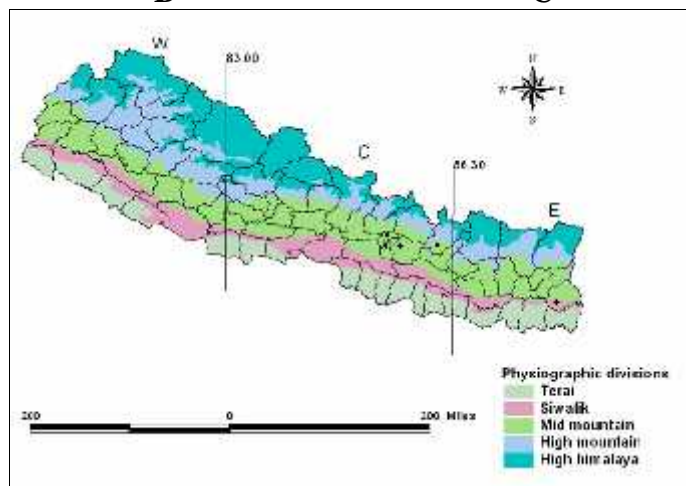


A



B

C



D

Fig. 18. *Cyanotis fasciculata* (Hayne ex Roth) Schultes; A. Illustration: a Habit Sketch, b., Sepal, c. Petals, d. Stamen, e. Carpel, f. Seed (J.P. Gajurel et al. 243); B. Inflorescence; C. Flower; D. Distribution map.

Eastern Nepal: Ilam, Ilam buspark to Campus, 1300m, 2006.10.27, J. P. Gajurel 283 (TUCH, KATH).

3.5 Cyanotis thwaitesii Hassk., Commel. Ind. 136. 1870. Hook, Fl. Brit. Ind. **6**: 388. 1892.

Type: Sri Lanka (Faden, Rev. Handb. Fl. Cey. **4**: 124. 2000).

Herbs annual, all parts covered with cobwebby hairs, decumbent. *Stems* tufted. *Leaves* spiral, 2--3 x 0.4--1 cm, linear-lanceolate, sessile, acuminate. *Inflorescence* axillary. *Flowers* bisexual, bracteoles falcate, bracts exceeds the cincinni, acuminate. *Sepals* 3, 3--4 mm, lanceolate. *Petals* 3, 3--4 mm, lobes ovate, obtuse, blue. *Stamens* 6, 4--6 mm, fertile, filaments with swelling below tip and bearded. *Carpels* 3 loculed ovary, 5--6 mm, style naked. *Capsules* oblong, little darker. *Seeds* ovate, pitted. Fl. Aug--Sept. Fr. Oct--Dec. (fig. 19).

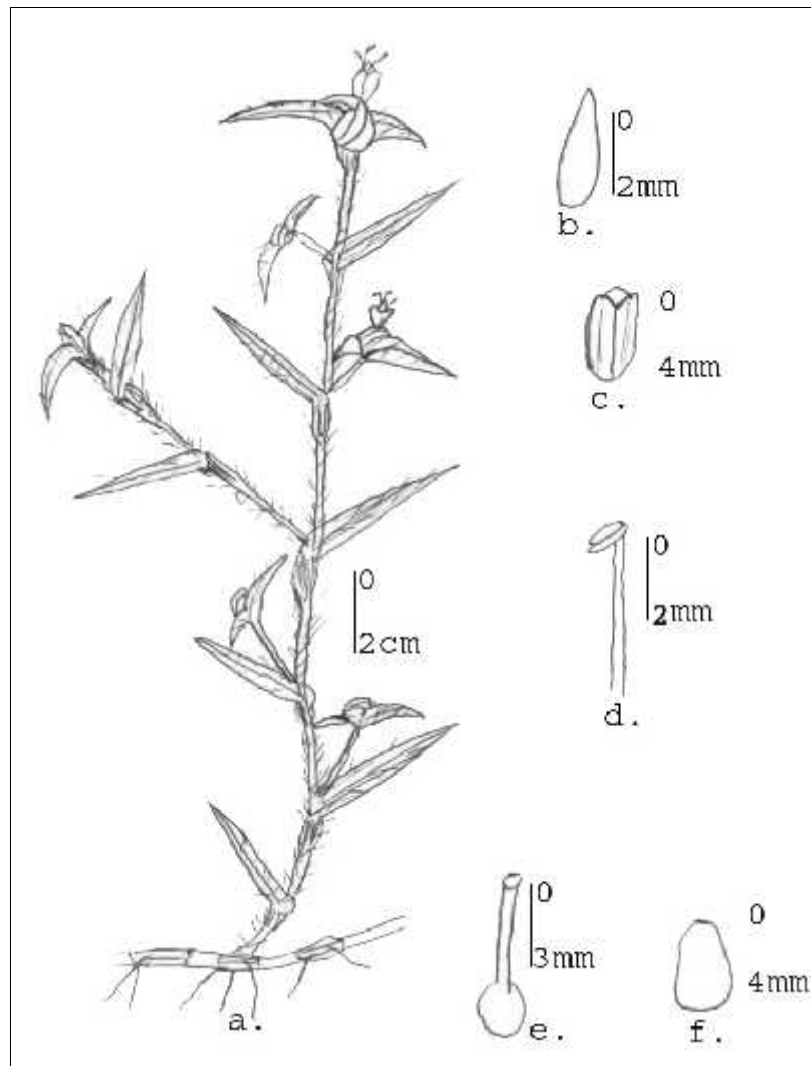
Ecology: Shady road side.

Distribution: Nepal (C), 1500-1600 m, Himalaya (Garhwal to Assam), Ceylon.

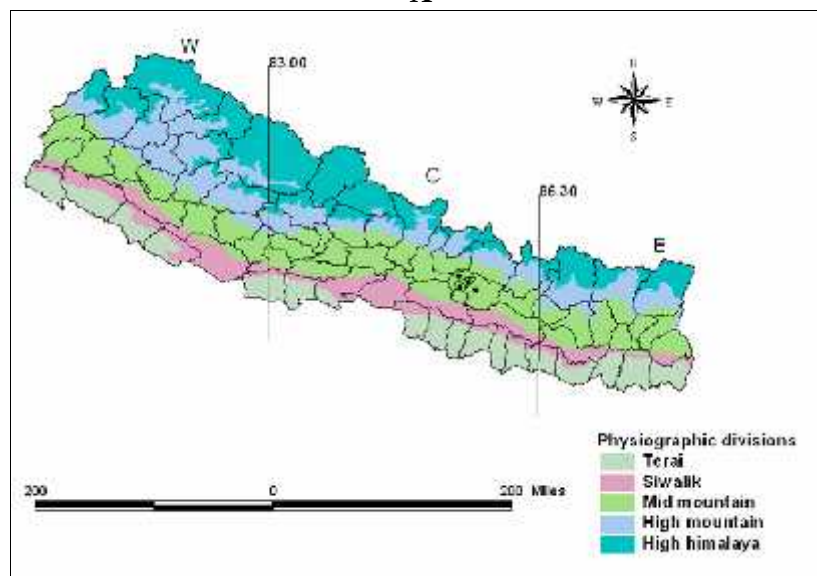
Note: This is new record for Nepal Flora collected by the author. The species has cobwebby hairs all over the body, inflorescence axillary, bracteoles lanceolate, bracts exceeding the cincinni, filament with swelling below the tip and capsule darker. These characters help to distinguish this species from *C. fasciculata*.

Specimens examined

Central Nepal: Kathmandu, Bhudhanilkhanta to Shivapuri, 1500m, 2007.08.11, J.P. Gajurel, 312 (TUCH, KATH). **Lalitpur**, Godawari to temple area, 1500m, 2007.11.08, J.P. Gajurel, 314 (TUCH, KATH). **Kavre**, From Phedi to Namobuddha, 1600m, 2006.10.04, J.P. Gajurel, 233 (TUCH, KATH).



A



B

Fig.19. *Cyanotis thwaitesii* Hassk.; A. Illustration, a. Habit Sketch, b. Sepal, c. Petal, d. Stamens, e. Carpel, f. Seed (J.P. Gajurel 312); B. Distribution map.

3.6 Cyanotis vaga (Lour.) J. A. & J. H. Schult., Syst. Veg. **2**: 1153. 1830. Hook, Fl. Brit. Ind. **6**: 387. 1892. Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978. Noltie, Fl. Bhutan **3** (1): 220. 2000. Press *et al*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps in Fl. China **24**: 22. 2000.

Type: *Tradescantia vaga* Lour., Flora Cochinchinensis **1**: 193-194. 1790.

Cyanotis barbata D. Don, Prodr. Fl. Nepa. 45. 1825 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

Herbs perennial, 4--29 cm. *Bulbs* globose. *Stems* branched. *Leaves* spiral, 3--6 x 0.4--1 cm, cauline, linear, lanceolate, slightly pubescent on margins. *Inflorescence* solitary or axillary, cyme, cincinni solitary. *Flowers* actinomorphic, bisexual. *Sepals* 3, 2--3 mm, oblong-lanceolate, connate at base. *Petals* 3, 3--4 mm, tubular, blue or pink. *Stamens* 6, 5--6 mm, fertile, equal, filaments sub apical swelling, anther locules longitudinally dehiscent. *Carpels* 3-loculed ovary, 5--6 mm, ovules 2 per locule. *Capsules* 3-valved, obovoid, trigonous. *Seeds* 2 per valve, reticulate. Fl. Aug--Sept. Fr. Oct--Nov. (fig. 20)

Ecology: Moist places near road or in margins of forest.

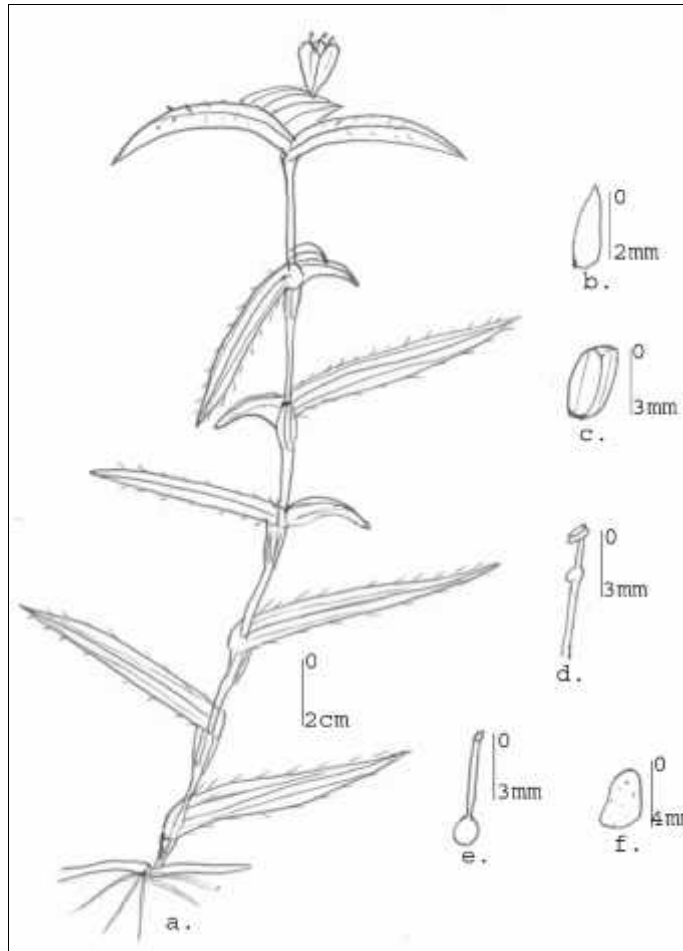
Distribution: Nepal (WCE), 800-2700 m, W. Africa, C. Asia, Himalaya, Assam, Burma, China.

Notes: The plant is very rare in lower elevation and dominant above 1400m. The plant can even grow on bed of *Pinus roxburghii*. The variation can be easily seen in size and pubescent. One specimen collected from Chapagaoun (J. P. Gajurel *et al.*, 242) is much larger than other collections and has a sparse pubescence. The variation in colour of petals from blue to pink can be seen some isolated population collected from Namobuddha (J.P. Gajurel 222). In some specimen collected from Khopasi (J.P. Gajurel 220) has 4 petals. Similarly, one species have corm collected from Charikot (J. P. Gajurel *et al.* 260). Hara *et al.* (6307425) collected this species from Ilam in 1963.10.13.

Specimens examined

Western Nepal: Bajhang, Dhuli, 2360m, 1976.07.25, K. R. Rajbhandary *et al.* 1610 (KATH).

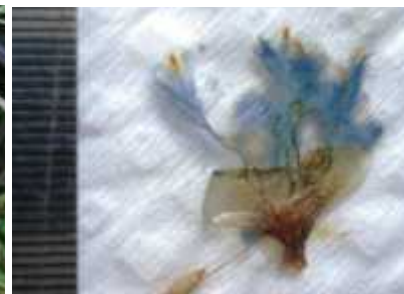
Central Nepal: Kathmandu, Kirtipur Bista gaon to Tindevi temple, 1550m, 2006.08.16, J.P. Gajurel *et al.* 130 (TUCH, KATH). Dakshinkali entry gate to temple, 1650m, 2006.08.29, J.P. Gajurel 167 (TUCH, KATH). On the way to Gokarna temple, 1400m, 2006.08.30, J.P. Gajurel 175 (TUCH, KATH). **Lalitpur,** Lamatar-7 to Sisnary, 1600m, 2006.09.07, J.P. Gajurel 196 (TUCH, KATH). Godawari to temple area, 1550m, 2006.08.24, J.P. Gajurel 151 (TUCH,



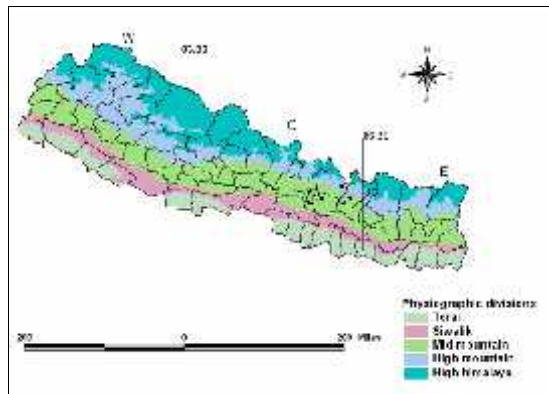
A



B



C



D

Fig. 20. *Cyanotis vaga* (Lour.) J. A. & J. H. Schult.; A. Illustration: a Habit Sketch, b., Sepal, c. Petals, d. Stamen, e. Carpel, f. Seed (J.P. Gajurel 203); B. Inflorescence; C. Flower; D. Distribution map.

KATH). Tikabhairab to Chapagaoun, 1550m, 2006.10.07, J. P. Gajurel *et al.*, 242 (TUCH, KATH). **Bhaktapur**, Dhadikot-2, Biruwa, 1450m, 2006.09.10, J.P. Gajurel 203 (TUCH, KATH). Nagarkot to Barak, 1950m, 2006.08.30, J.P. Gajurel 174 (TUCH, KATH). **Kavre**, Panauti riverside, 1500m, 2006.08.26, J.P. Gajurel 160 (TUCH, KATH). On way to Khopasi powerhouse, 1500m, 2006.09.27, J.P. Gajurel 220 (TUCH, KATH). On way to Namobuddha, 1500m, 2006.10.04, J.P. Gajurel 222 (TUCH, KATH). **Sindhupalchok**, Tatopani to Custom office, 1400m, 2006.10.20, J.P. Gajurel 267 (TUCH, KATH). **Dolakha**, Charikot to Dolakha Bhimsen, 1500m, 2006.10.15, J. P. Gajurel *et al.* 260 (TUCH, KATH).

4. FLOSCOPA Loureiro, Fl. Cochinch. **1**: 189, 192. 1790.

Type: *Floscopa scandens* Lour. - Flora Cochinchinensis **1**: 193. 1790.

Herbs perennial. *Rhizomes* long. *Stems* erect. Leaves sessile, alternate, elliptic to lanceolate. *Inflorescences* broom like, panicle, solitary or several, terminal or axillary, cincinni numerous, bracts small. *Flowers* actinomorphic. *Sepals* 3, free, shallowly to strongly boat-shaped, leathery, persistent. *Petals* 3, free, obovate, clawed, blue, purple or white. *Stamens* 6, 3 or all fertile, equal, filaments glabrous, anther locules connate, ellipsoid, longitudinally dehiscent. *Carpel* 2-loculed ovary, ovules 1 per locule. *Capsules* 2-valved, slightly flattened. *Seeds* 1 per valve, hemispheric, reticulate or striate, hilum linear.

About 20 species are found in the world, in pantropical region (Deyuan and DeFilipps, 2000). One species of *Floscopa* is found in Nepal (Press *et al.*, 2000).

4.1 Floscopa scandens Loureiro, Fl. Cochinch. **1**: 193. 1790. Hook, Fl. Brit. Ind. **6**: 390. 1896. Hara, Enum. Fl. Pl. Nep. **1**: 82 . 1978. Noltie, Fl. Bhutan. **3** (1): 225. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps, Fl. Ch. **24**: 25. 2000.

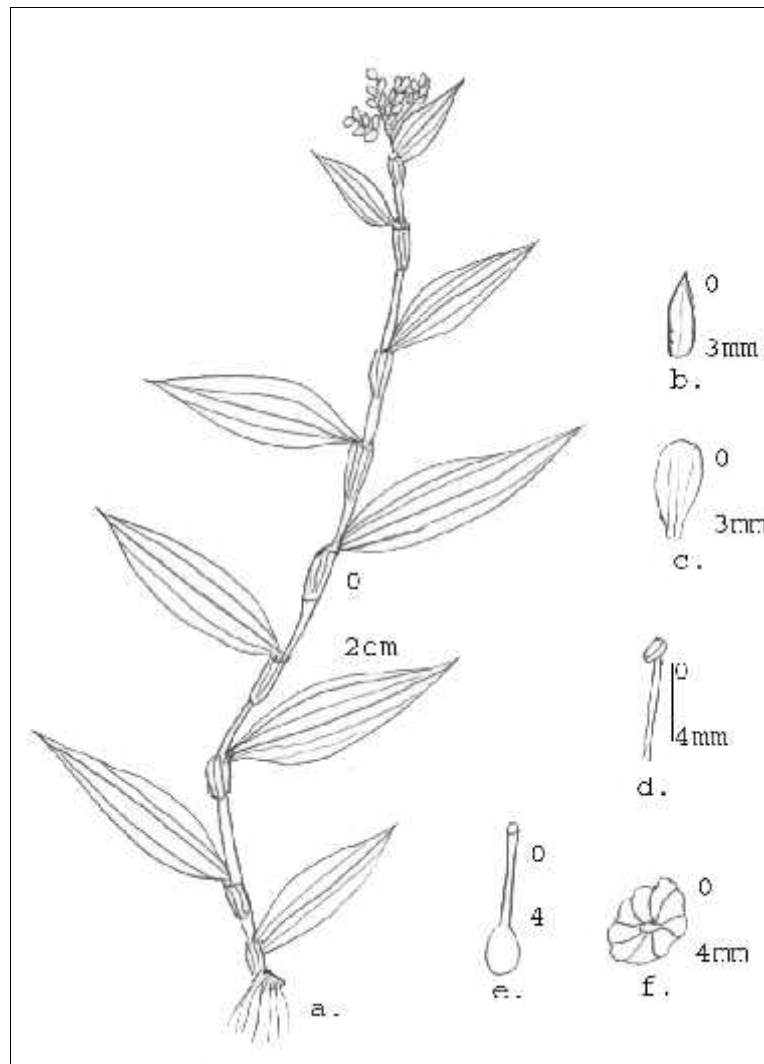
Type: Loureiro, Vietnam (Cochichina). (Rev. Handb. Fl. Cey. **4**: 117-197. 2000).

Aneilema hispida D. Don, Prodr. 45. 1825 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

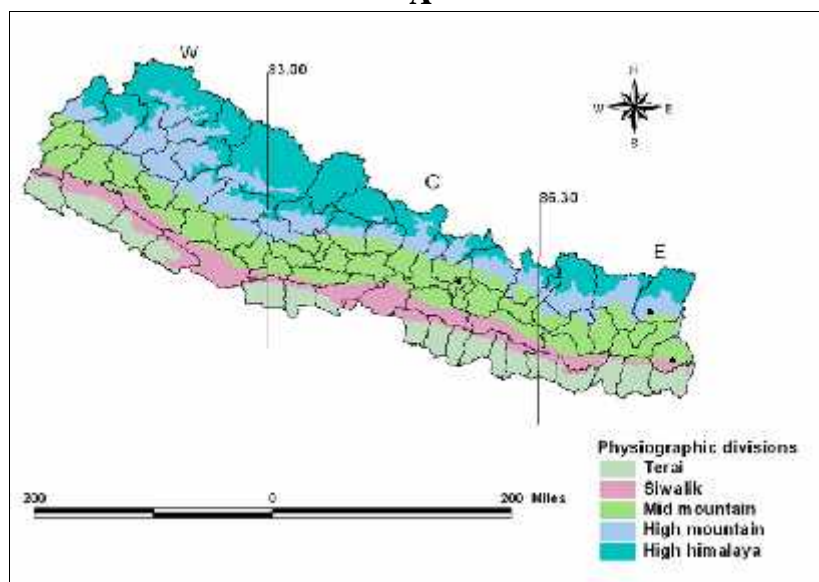
Floscopa hamiltonii (Spreng.) Hassk., Commel. Ind. 166-167. 1870 (Hook., Fl. Brit. Ind. **6**: 374. 1892).

Tradescantia paniculata Roxb. Corom. 2: 6, t. 109. 1799 (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Herbs perennial, 40--60 cm. *Rhizomes* long. *Stems* erect. *Leaves* alternate, 2--11×1--2 cm sessile, elliptic to lanceolate. *Inflorescences* broom like, panicle, cincinni numerous. *Flowers* actinomorphic. *Sepals* 3, 3--4 mm, free, boat-shaped, leathery,



A



B

Fig. 21. **Floscopa scandens** Loureiro; A. Illustration: a Habit Sketch, b. Flower, c. Fruit (C. Grey-Wilson *et al.* 149); B. Distribution map.

persistent. *Petals* 3, 4--5 mm, free, obovate, clawed, blue or purple. *Stamens* 6, 3 or all fertile, equal, filaments glabrous, anther locules connate. *Carpels* 2-loculed ovary, ovules 1 per locule. *Capsules* 2-valved, ovoid, compressed. *Seeds* 1 per valve, reticulate, semi ellipsoid, hilum linear. Fl. Jul--Nov. Fr. Nov--Dec. (fig. 21).

Ecology: Water drainage near road.

Distribution: Nepal (CE), 500-1800 m, Himalaya, India, China, Taiwan, Malaysia, Australia.

Notes: The inflorescence is broom like and flower being blue to purple. This plant is relatively not so dominant in some places.

Specimens examined

Central Nepal: Kaski, On way to Ghandruk, 1400m, 2005.08.12, J. P. Gajurel et al. 26 (TUCH). **Nuwakot**, busbark, 1120m, 1979.11.14, N. P. Manandhar 3083 (TUCH, KATH). **Kathmandu**, Sundarijal, 1400m, 1997.09.13, P. Pradhan 129 (TUCH, KATH).

Eastern Nepal : Sankhuwasaba, Tamur valley, 1000m, 1989.09.01, C. Grey *et al.* 149 (TUCH, KATH). **Ilam**, Chulachuli, 1200m, 1972.09.18, T.B. Shrestha *et al.* 941 (TUCH, KATH).

5. MURDANNIA Royle, *Illus.Bot. Himalayan*

Type: *Murdannia scapiflora* (Roxb.) Royle., *Ill. Bot. Himal.*: 95.1839.

Herbs perennial or annual. *Roots* fusiform. *Rhizomes* present or absent. Stems creeping or ascending. *Leaves* alternate, linear. *Inflorescence* cyme, cincinni solitary or numerous. *Flowers* actinomorphic. *Sepals* 3, free, boat-shaped. *Petals* 3, free, purple, blue, pink or yellow, orbicular or obovate. *Stamens* 6, fertile stamens 3, filaments glabrous or hairy, anther locules longitudinally dehiscent, staminodes absent or 3, inserted opposite to petals, antherodes sagittate or 3-sect. *Carpels* 3-

loculed ovary, ovules 1--7 per locule. *Capsules* 3-valved, ovoid, ellipsoid, or globose. *Seeds* 1 or 2 per valve, quadrangular, reticulate, rugose, hilum orbicular.

About 50 species are found in the world, in tropical and subtropical regions (Deyuan and DeFilipps, 2000). Eight species of *Murdannia* are found in Nepal (Press *et al.*, 2000). Present study confirms 10 species and 1 variety. Two species and one variety are new for Nepal Flora. However, one species is doubtful.

Table 7: Comparative Morphology of Species of *Murdannia* in Nepal

S. N.	Name of the Genera	Habit	Root	Stem	Inflorescence	capsule	Seeds
1.	<i>Murdannia blumei</i> (Hassk.) Brenan	Annual	Fusiform	Decumbent	terminal or axillary	3-valved, oblong-ellipsoid	1 or 2 per valve, polygonal to rectangular
2.	<i>Murdannia dimorphoides</i> Faden	Perennial	Fusiform	Erect with distinct base	terminal	oblong-ellipsoid	3-4 per valve
3.	<i>Murdannia divergens</i> (C. B. Clarke) Bruc.	Perennial	Fibrous	Erect, pubescent	terminal	obovoid or ellipsoid	3--5 per valve
4.	<i>Murdannia edulis</i> (Stokes) Faden	Perennial	Fibrous	Scapiform	terminal	ellipsoid, trigonous	7 per valve, flattened, reticulate.
5.	<i>Murdannia japonica</i> (Thunb.) Faden	Perennial	Fibrous	Undeveloped	terminal	ellipsoid	2--4 per valve, tetragonal
6.	<i>Murdannia keisak</i> (Hassk.) Hand.-Mazz.	Annual	Fibrous	Creeping proximally, ascending distally	terminal	ovoid, trigonous,	4 per valve, flattened
7.	<i>Murdannia medica</i> (Loureiro) D. Y. Hong	Annual	Fusiform	Slender, ascending	terminal	ovoid-globose, trigonous	3-7 per valve, reticulate, rugose
8.	<i>Murdannia nudiflora</i> (L.) Brenan.	Annual	Fusiform	Decumbent,	terminal and axillary	oblong, globose	2 per valve, verrucose.
9.	<i>Murdannia spirata</i> (L.) Bruckn.	Annual	Fibrous	Decumbent	terminal and axillary	oblong trigonous	3-7 per valve, reticulate
10	<i>Murdannia vaginata</i> (L.) Bruckn.	Annual	Fibrous	Creeping or slightly robust	terminal or axillary	Stipitate ovoid	1 per valve

Key to the Species of Murdannia

- 1.a. Herbs perennial, inflorescence terminal 2
- 1.b. Herbs annual, inflorescence axillary or solitary 5
- 2.a. Roots tuberous, capsule obovoid 4
- 2.b. Roots fibrous or fusiform, capsule ellipsoid 3
- 3.a. Cincinni whorled, capsule trapazoyal *M. dimorphoides*
- 3.b. Cincinni free, capsule ellipsoid *M. japonica*
- 4.a. Stem scapiform, leaves absent on stem with inflorescence *M. edulis*
- 4.b. Stem erect, leaves present on stem with inflorescence *M. divergens*
- 5.a. Inflorescence solitary, capsule ovoid or globose 6
- 5.b. Inflorescence axillary, capsule ellipsoid oblong7
- 6.a. Inflorescence solitary, capsule ovoid or globose 7
- 6.b. Inflorescence axillary, capsule ellipsoid oblong8
- 7.a. Leaves elliptic, seeds 4 per valve, flattened *M. keisak*
- 7.b. Leaves lanceolate, seeds 2 per valve, reticulated *M. nudiflora*
- 8.a. Stem decumbent, seeds 1 to several per valve9
- 8.b. Stem creeping and slightly robust, seeds 1 per valve *M. vaginata*
- 9.a. Capsule ovoid, filaments pubescent 10
- 9.b. Capsule ellipsoid, filaments glabrous *M. blumei*
- 10.a. Leaves linear and basal rosette form present *M. medica*
- 10.b. Leaves lanceolate-ovate and basal rosette form absent *M. spirata*

5.1 Murdannia blumei (Hassk.) Brenan, Pl. **36**: 3578. 1962. Hook, Fl. Brit. Ind. **6**: 285. 1892. Hara, Enum. Fl. Pl. Nep. **1**: 83 .1978. Noltie, Fl. Bhutan **3** (1): 230. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000.

Type: *Dichospermum blumei* Hassk., Commelinaceae Indicae : 41. 1870.

Aneilema blumei (Hassk.) Bakh. f., Blumea. **6**: 398. 1950 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Aneilema hamiltonianum Wall. ex C. B. Clarke, Monogr. Phan. **3**: 213. 1881 (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Herbs annual. *Roots* fusiform thickened. *Rhizomes* present or absent. *Stems* decumbent. *Leaves* spiral, 1--6 x 0.5--1 cm, lanceolate or linear lanceolate, acute to acuminate. *Inflorescence* terminal or axillary cyme, cincinni solitary or numerous. *Flowers* actinomorphic, bisexual. *Sepals* 3, 0.6 x 0.2 mm, glabrous, free, boat-shaped. *Petals* 3, 0.5 x 0.2 cm, free, elliptic to obovate-elliptic, pale pink to lilac. *Stamens* 6,

3 fertile, filaments glabrous, anther locules longitudinally dehiscent, staminodes 3, inserted opposite petals, antherodes sagittate or 3-sect. *Carpels* 3-loculed ovary, stigma capitate, ovules 1--7 per locule. *Capsules* 3-valved, oblong- ellipsoid. *Seeds* 1 or 2 per valve, polygonal to rectangular, hilum elliptic. Fl. Jan--Feb. Fr. Mar--Apr.

Ecology: Marshy place.

Distribution: Nepal (E), (1200-) 1400 m, Himalaya, India, Burma, Malaysia.

Note: The specimens of this species are not deposited in the herbaria of Nepal. The specimen has been deposited in TI collected by Hara *et al.*(6305473) from Ilam in 1963.10.13.

5.2 Murdannia dimorphoides Faden, Novon **11**: 22-30. 2001.

Type: Sri Lanka (Faden, Rev. Handb. Fl. Cey. **4**: 154. 2000).

Herbs perennial. *Roots* fusiform. Stems repent. *Leaves* alternate, 1--3 X 0.4--0.6 cm, linear to lanceolate oblong. *Inflorescence* terminal, cincinni whorled. *Flowers* bisexual or male. *Sepals* 3, free, lanceolate -oblong. *Petals* 3, free, obovate, lavender. *Stamens* 6, 4--6 mm, fertile stamens 3, filaments densely bearded basely, anther 3 lobed, staminodes 3, filaments densely bearded basely, anther 3 lobed. *Carpels* 3-loculed ovary, 4--6 mm, ovules 1--7 per locule. *Capsules* oblong-ellipsoid. *Seeds* 3 or 4 per valve, trapazoyal, hilum oblong. Fl. Jul--Aug. Fr. Sep--Dec. (fig. 22).

Ecology: Shady and sandy place.

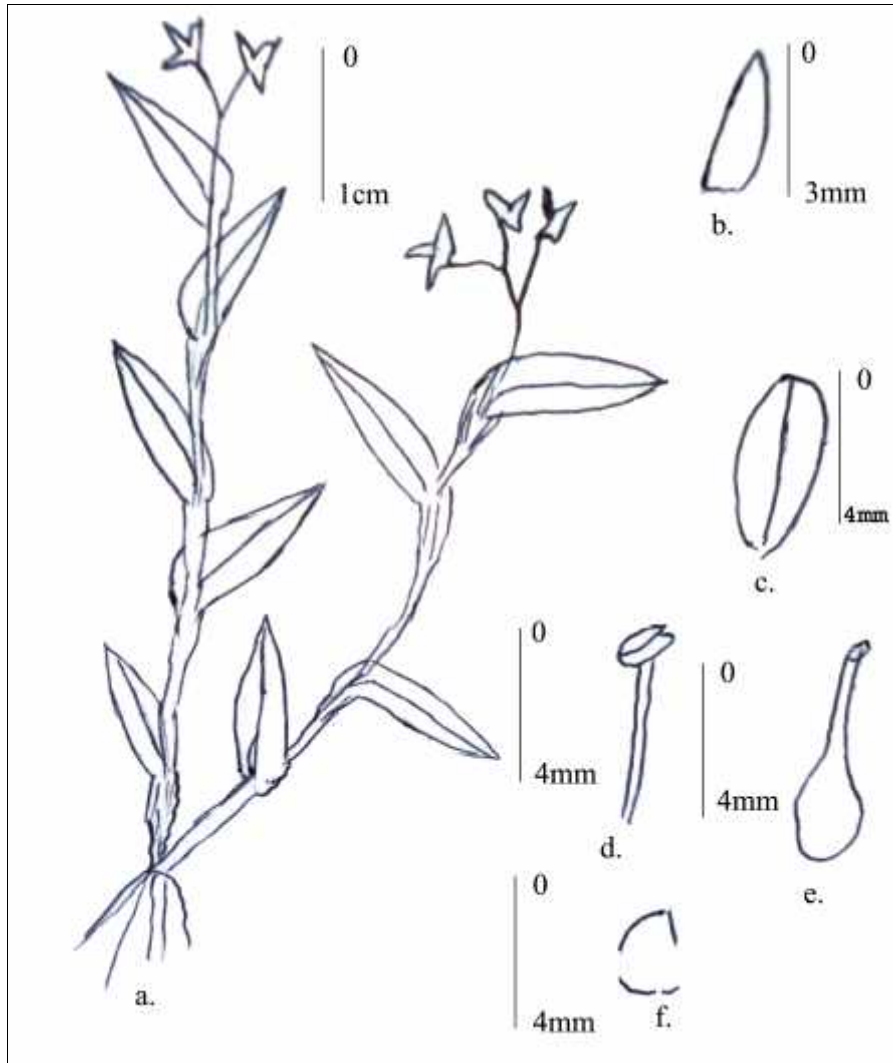
Distribution: Nepal (CE), 100-1600 m, Himalaya (Garhwal to Assam), China.

Note: This species is new for Nepal Flora. The species has both its often whorled cincinni, bicoloured antherode, lacking dark veins in petals, bearded stamens. Further study is required.

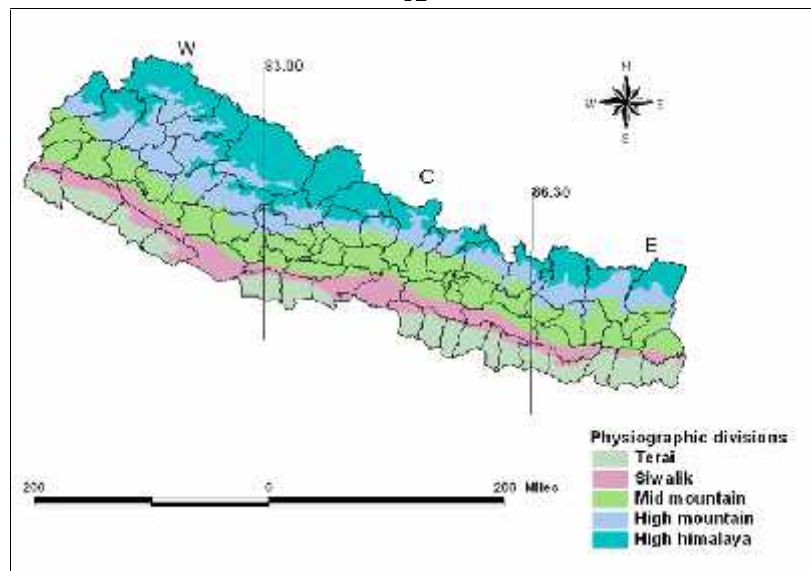
Specimens examined

Central Nepal: Kathmandu, Kirtipur Behind Nepali Dept., 1320m, 2006.08.14, J.P. Gajurel 120 (TUCH, KATH). **Kathmandu**, Near management building, Kirtipur, 1350m, 2006.08.21, J.P. Gajurel, 145. **Lalitpur**, Godawari to temple area, 1500-1600m, 2007.08.11, J.P. Gajurel, 315 (TUCH, KATH).

Eastern Nepal: Jhapa, Garamuni, Jhapa, 100m, 2006.10.26, J.P. Gajurel, 279 (TUCH, KATH).



A



B

Fig. 22. *Murdannia dimorphoides* Faden; A. Illustration, a. Habit Sketch, b. Sepal, c. Petal, d. Stamens, e. Carpel, f. Seed (J.P. Gajurel 120); B. Distribution map.

5.3 Murdannia divergens (C. B. Clarke) Bruc., Engler & Prantl, Nat. Pflanzenfam., ed. 2. **15a**: 173. 1930. Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978. Noltie, Fl. Bhutan **3** (1): 228. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps in Fl. China **24**: 29. 2000.

Type: *Aneilema herbaceum* var. *divergens* C.B. Clarke J. L. Soc. Bot., **11**: 448. 1871.

Aneilema divergens (C. B. Clarke) C. B. Clarke, Commel & Cyrt. Bengh. T. 16. 1874 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Aneilema longifolium Wall., Numer. List : 181, n. 5213. 1832 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Herbs perennial, 15--50cm. *Roots* tuberous. *Rhizomes* absent. *Stems* erect, pubescent. *Leaves* alternate, 2--11 x 0.5--1.5 cm, all cauline, acute, lanceolate, glabrous. *Inflorescence*, terminal, cyme, cincinni numerous, opposite or whorled. *Flowers* bisexual, pedicellate. *Sepals* 3, 3--7 mm, ovate-orbicular, persistent. *Petals* 3, 3--7 mm, obovate-orbicular, purple-red to purple-blue. *Stamens* 6, 5--6 mm, pubescent, fertile stamens 3, staminodes 3, antherodes 3-sect. *Carpels* 3-loculed ovary, 5--6 mm. *Capsules* obovoid or ellipsoid. *Seeds* 3--5 per valve. Fl. Jun--Sep. Fr. Aug--Sep. (fig. 23)

Ecology: Wet forest margin.

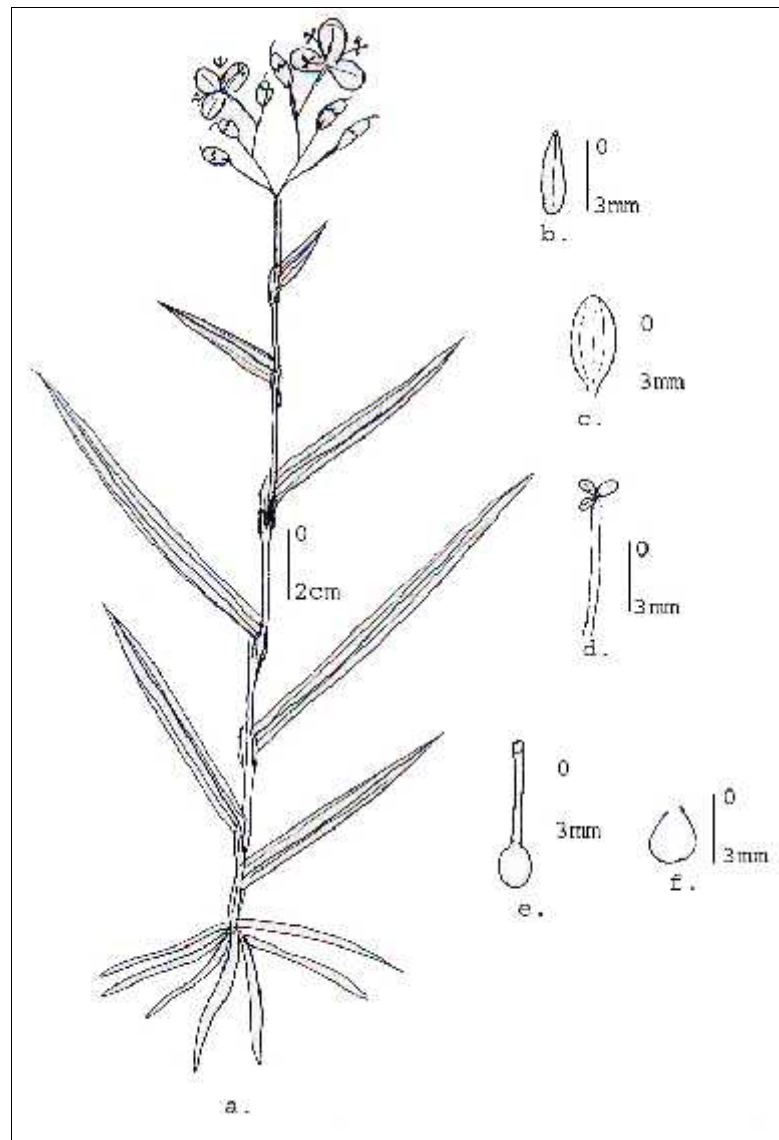
Distribution: Nepal (WC), (1200-) 1500-2400 m, Himalaya, India, Burma.

Notes: The leaves are basal and roots are tuberous and the fruit is beaked. The flower is light purple. This plant loves moist shady place and is dominant even on the bed of Pine forest.

Specimens examined

Western Nepal: Salyan, buspark, 1200m, 1968.08.09, S.B. Malla 14014 (KATH).

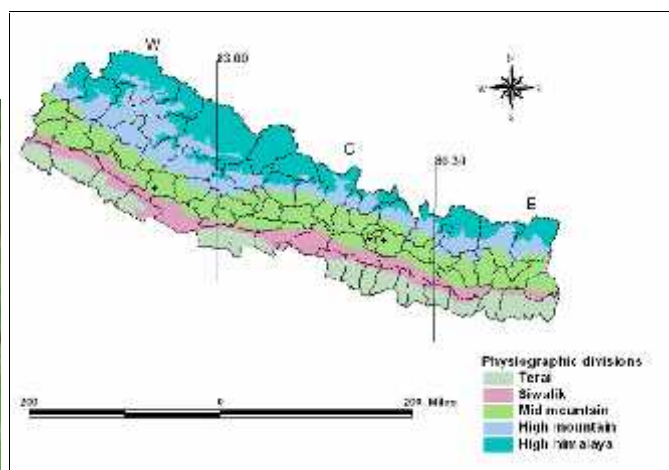
Central Nepal: Kathmandu, Dakshinkali Mai temple area, 1600m, 2006.08.02, J.P. Gajurel 97 (TUCH, KATH). Kavre, Dhulikhel devithan, 1700m, 2006.08.10, J.P. Gajurel *et al.* 111 (TUCH, KATH).



A



B



C

Fig. 23. *Murdannia divergens* (C. B. Clarke) Brückner; A. Illustration: a Habit Sketch, b., Sepal, c. Petals, d. Stamen, e. Carpel, f. Seed (J.P. Gajurel 97); B. Inflorescence; C. Distribution map.

5.4 *Murdannia edulis* (Stokes) Faden, Taxon **29** (1): 77. 1980. Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978. Noltie, Fl. Bhutan **3** (1): 228. 2000. Deyuan and DeFilipps, Fl. China **24**: 28. 2000.

Type: *Murdannia scapiflora* (Roxb.) Royle., Ill. Bot. Himal.: 95.1839.

Aneilema scapiflorum (Roxb.) Kostel., Allg. Med. Pharma. Fl. **1**: 127. 1831 (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Commelina edulis Stokes, Bot. Materia Med. **1**: 184. 1812 (Hara, Enum. Fl. Pl. Nep. **1**: 81. 1978).

Herbs perennial, 11--29 cm. *Roots* fibrous or fusiform. *Rhizomes* absent. *Stems* scapiform. *Leaves* alternate, 2--5 x 0.5--1 cm, basal, rosulate, linear, glabrous, acuminate. *Inflorescence* terminal cyme, cincinni 2 or more flowered, pedicellate. *Flowers* bisexual. *Sepal* 3, 4--6 mm, lanceolate, persistent. *Petals* 3, 5--9 mm, pink or purple, obovate-orbicular. *Stamens* 6, Fertile stamens 3, filaments bearded, staminodes 3, antherodes 3 sect. *Carpels* 3 locular ovary. *Capsules* ellipsoid, trigonous. *Seeds* 7 per valve, flattened, reticulate. Fl. Jun--Aug. Fr. Aug--Sept. (fig. 24).

Ecology: Moist shady place.

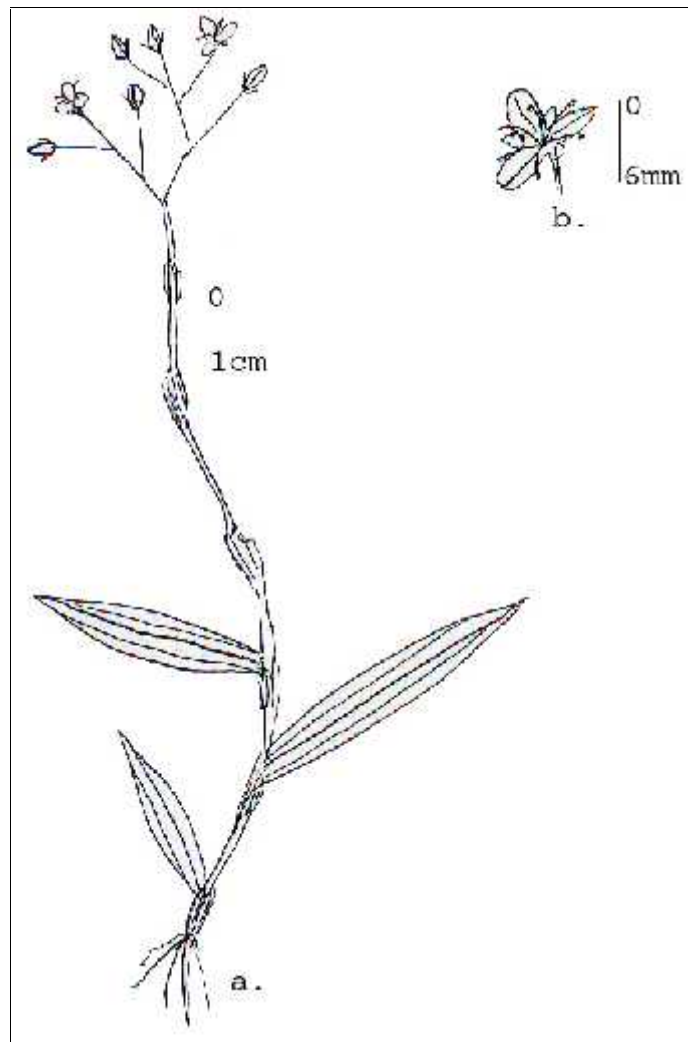
Distribution: Nepal (WCE), 180 m, Himalaya, India, Ceylon, Burma.

Notes: The stem is scapiform. The roots are fusiform. The leaves are found in base. The species has been collected from Eastern Nepal by Stainton 5758 (Enum. Fl. Pl. Nep. **1**: 83. 1978). From the study, it was found that species (Manandhar 8244) also are located in Western Nepal.

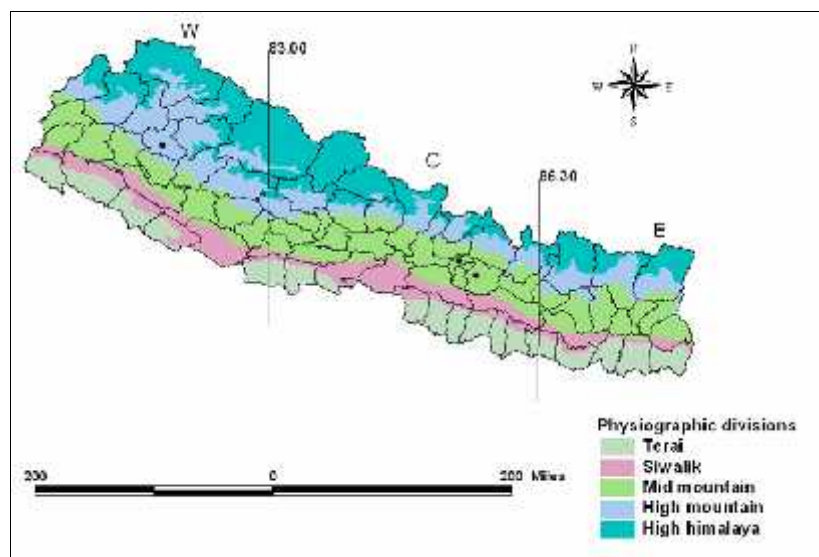
Specimen examined

Western Nepal: Kalikot, Nagma, 2000m, 1981.08.12, N.P. Manandhar 8244 (KATH).

Central Nepal: Kathmandu, To Mai than, Dakshinkali, 1600-1700m, 2007.08.14, J.P. Gajurel, 317 (TUCH, KATH).



A



B

Fig. 24. *Murdannia edulis* (Stokes) Faden; A. Illustration: a Habit Sketch, b. Flower (J.P. Gajurel, 317); B. Distribution map.

5.5 *Murdannia japonica* (Thunb.) Faden, Taxon **26**: 142.1977. Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978. Noltie, Fl. Bhutan **3** (1): 226. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps in Fl. Ch. **24**: 28. 2000.

Type: *Commelina japonica* Thunb. Trans. L. S. London **2**: 332. 1794.

Aneilema lineolatum (Blume) Kunth, Enum. Pl. **4**: 69. 1843 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Murdannia elata (Vahl) Bruckn., Engl. & Prantl, Pflanzenfam. Ed. 2, 15a: 173. 1930 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Commelina elata Vahl, Enum. Pl. **2**: 178. 1806 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Herbs perennial. *Roots* fibrous. *Rhizomes* absent. *Stems* undeveloped, glabrous. *Leaves* alternate, 8--15 × 1.5--4.5 cm, basal, rosulate, elliptic, glabrous, base connate, apex obtuse, acute, or shortly acuminate. *Inflorescence* terminal cyme, cincinni many, glabrous. *Flowers* 2 to several, fertile, bisexual, pedicellate. *Sepals* 3, 1--6 mm, narrowly elliptic, persistent. *Petals* 3, 1--6 cm, obovate-orbicular, purple or blue. *Stamens* 6, fertile stamens 2 or 3, filaments pubescent, staminodes 3, antherodes 3-sect. *Carpels* 3 locular ovary. *Capsules* ellipsoid. *Seeds* 2--4 per valve, tetragonal, hilum verrucose. Fl. Aug--Sep. Fr. Aug--Sep.

Ecology: Forest margin.

Distribution: Nepal (CE), 400-2000 m, Himalaya (Nepal to Bhutan), India, Burma, China, Malaysia.

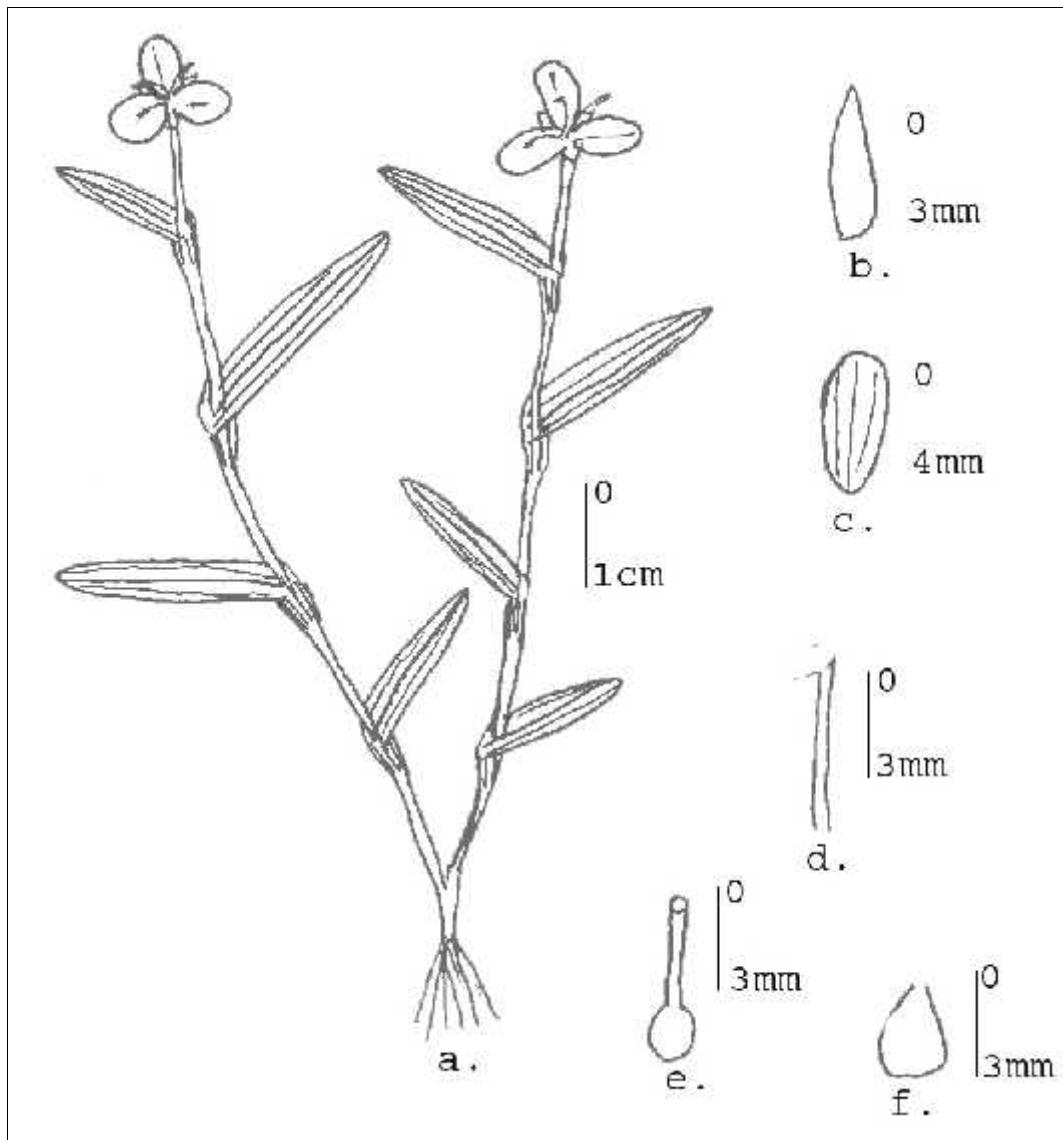
Note: The specimens of this species are not deposited in the herbaria of Nepal. The specimen has been deposited in TI collected by Hara *et al.*(6305475) from Ilam in 1963.12.09.

5.6 *Murdannia keisak* (Hassk.) Hand.-Mazz., Symb. Sin. **7**: 1243. 1936. Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978. Press *et al.*, Ann. Check. Fl. Nep. :48. 2000. Deyuan and DeFilipps in Fl. China **24**: 27. 2000.

Type: *Aneilema keisak* Hassk. Commelinaceae Indicae. 32. 1870.

Aneilema keisak Hassk. Commelinaceae Indicae. 32. 1870 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

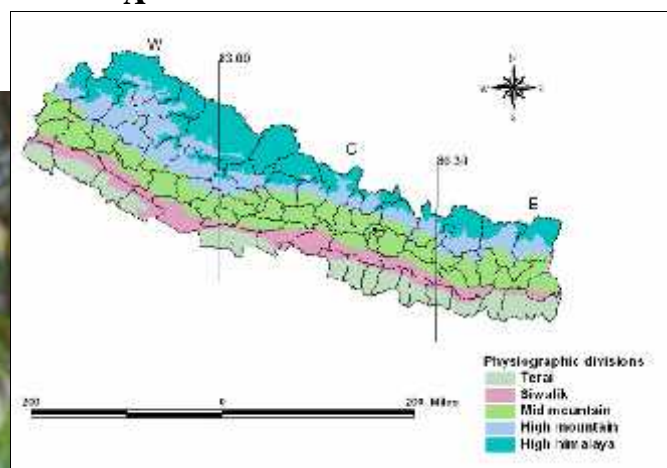
Herbs annual, 6--12cm. *Roots* fibrous. *Rhizomes* horizontal, elongate. *Stems* creeping proximally, ascending distally. *Leaves* alternate, 1--3 x 0.3--0.5 cm, sessile, linear-lanceolate or linear-elliptic, acuminate. *Inflorescence* terminal cyme, cincinnati 1-



A



B



C

Fig. 25. *Murdannia keisak* (Hassk.) Hand.-Mazz.; A. Illustration: a Habit Sketch, b., Sepal, c. Petals, d. Stamen, e. Carpel, f. Seed (J.P. Gajurel 183); B. Inflorescence; C. Distribution map.

flowered, pedicellate. *Flowers* bisexual. *Sepals* 3, 2--4 mm, oblong. *Petals* 3, 2--5 mm, obovate purple. *Stamens* 6, 4--6 mm, fertile stamens 3, filaments bearded, staminodes 3, antherodes sagittate. *Carpels* 3 locular ovary, 4--6 mm. *Capsule* ovoid, trigonous, acute to sub acuminate at both ends. *Seeds* 4 per valve, flattened. Fl. Aug--Sep. Fr. Sep--Oct. (fig. 25).

Ecology: In wet places..

Distribution: Nepal (C), 1100 (-1400) m, Nepal, China, N. Indo-China, Korea, Japan.

Note: The flower is terminal with fibrous root. The petals are equal in size and colour is purple at margin and white in remaining parts. The plant is dominant in wet places as in rice field. The specimens of this plant have not been deposited in herbaria of Nepal. The altitude on which this species is collected by the author is 1200-1400m. The flowering time is usually 8am to 11am.

Specimen examined

Central Nepal: Kathmandu, Bhudhanilkhanta to Shivapuri, 1400m, 2006.09.01, J.P. Gajurel 183 (TUCH, KATH).

5.7 *Murdannia medica* (Loureiro) D. Y. Hong, Acta Phytotax. Sin. **12**: 470. 1974.

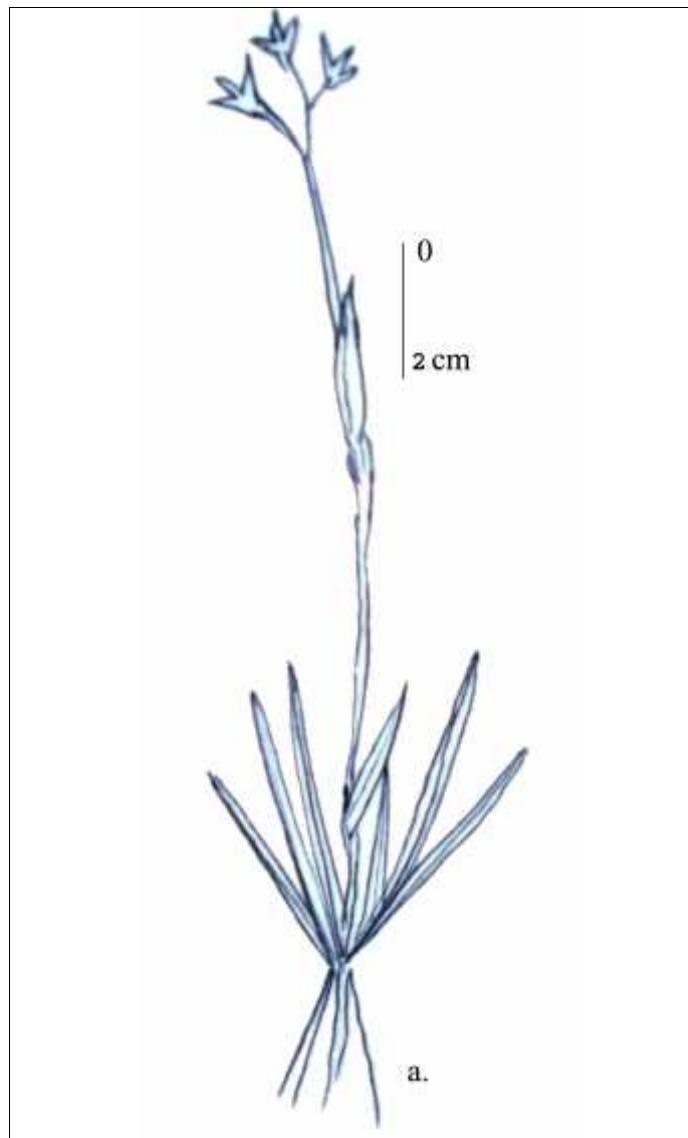
Type: Vietnam, Hue and vicinity (NT) (Faden, *Novon.* **11**: 22-30. 2001).

Herbs perennial. *Roots* fusiform. *Stems* ascending. *Leaves* alternate, 1--4 x 0.5--0.8 cm, linear, basal rosette, recurved, fleshy, glabrous. *Inflorescence* terminal along the bladeless sheath. *Flowers* with cincinni 1 flowered. *Sepals* 3, glabrous. *Petals* 3, free, purple. *Stamens* 6, fertile stamens 2, filaments hairy, antherodes trilobed, staminodes 4. *Capsules* sessile, oblong elliptic. *Seeds* 3 to 7 per valve, deltate, pitted, hilum linear. (fig. 26).

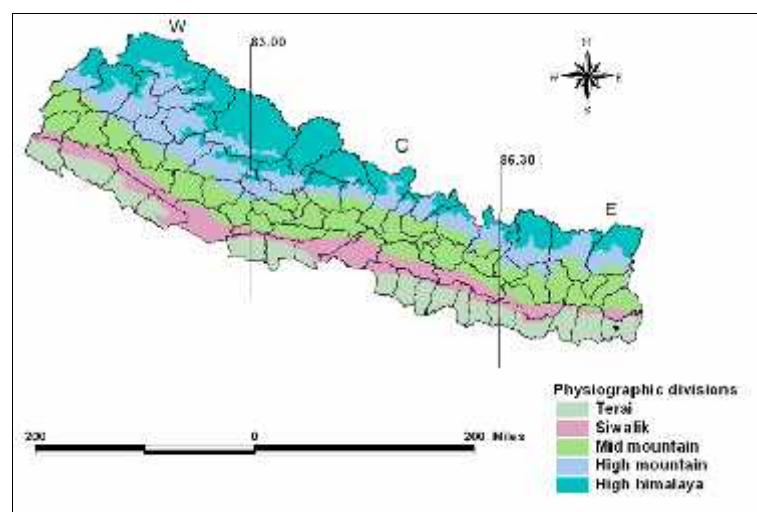
Ecology: Shady and sandy place.

Distribution: Nepal (E), ca. 150 m, Himalaya (Garhwal to Assam), China.

Note: This is new record for Nepal flora. *Murdannia medica* is distinct from other species of *Murdannia* from peculiar inflorescence and floral structure. The elongate bladeless sheaths enclosing one flowered cincinni, 4 subequal staminodes and trilobed antherode are diagnostic characters of the *Murdannia medica*. This species is very close to *Murdannia vaginata*. It need further study.



A



B

Fig. 26. *Murdannia medica* (Loureiro) D. Y. Hong; A. Illustration, a. Habit Sketch (D.H. Nicolson 3056); B. Distribution map.

Specimens examined

Eastern Nepal: Jhapa, Forest Near Bhadrapur, 150m, 1967.03.30, D.H. Nicolson 3056 (KATH).

5.8 *Murdannia nudiflora* (L.) Brenan., Kew Bull. 1952 : 189. 1952. Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978. Noltie, Fl. Bhutan **3** (1): 229. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps, Fl. China **24**: 20. 2000.

Type: *Aneilema hispida* D.Don. Prodr. Fl. Nepal : 45. 1825

Commelina nudiflora L. Sp. Pl. **1**: 41-42. 1753 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Aneilema nudiflorum (L.) R.Br., Prodr. 271. 1810 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Tradescantia malabarica L. , Sp. Pl. ed.2, 412. 1762 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Commelina nudicaulis Burm. F., Fl. Ind. 17, t. 8, f. 1. 1768 (Faden, Rev. Handb. Fl. Cey. **4**: 145. 2000).

Murdannia malabarica (L.) Bruckn., Pflanzenfam., ed. 2, 15a: 173. 1930 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

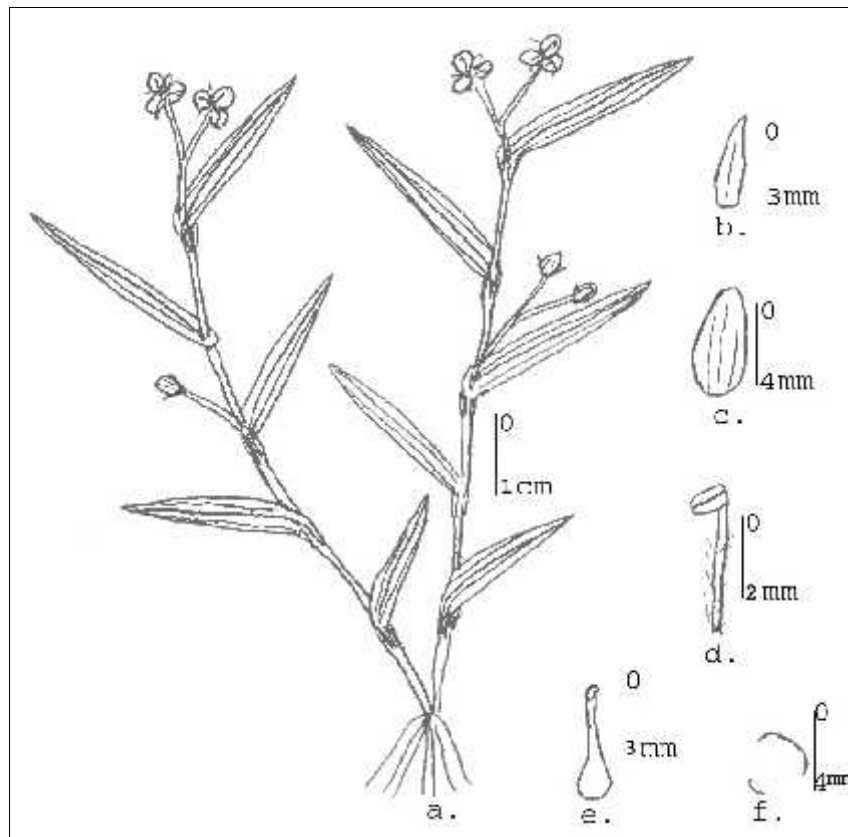
Aneilema nudicaulis (Burm. F.) Loudon, Hort. Brit. 15. 1839 (Faden, Rev. Handb. Fl. Cey. **4**: 145. 2000).

Herbs annual, 22--46cm. *Roots* fusiform. *Rhizomes* absent. *Stems* slender, ascending. *Leaves* alternate, 2--7 × 0.3--0.6 cm, sessile, entire, linear to lanceolate, sheath ciliate margins. *Inflorescence* terminal cyme. *Flowers* bisexual. *Sepals* 3, 0.3 x 0.2 cm, free, ovate-elliptic. *Petals* 3, 0.5 x 0.4 cm, free, purple, obovate-orbicular. *Stamens* 3, 4--5 mm, filament hairy, anthers pale yellow, staminodes 3, white. *Carpels* 3-loculed ovary, 4--5 mm. *Capsules* ovoid-globose, trigonous. *Seeds* 2 per valve, reticulate, rugose, hilum orbicular. Fl. Jun--Aug. Fr. Aug--Sep. (fig. 27).

Ecology: Found in moist places .

Distribution: Nepal (WCE), (100-) 200-1500 (1700) m, Himalaya, India, China, Burma, S. Japan, Malaysia, Africa.

Note: This plant is dominant and larger in size when it is found in moist places with more organic matter. In dry parts, the plant is small. In Terai region (Eastern Nepal, J.P. Gajurel, 275), the plant size is large as compared to other places. Some specimens were relatively large, and leaves are linear elongated and slightly ciliate at margin. The elevation range found during study is 100-1700m. Flowering time is usually 7am to 11am.



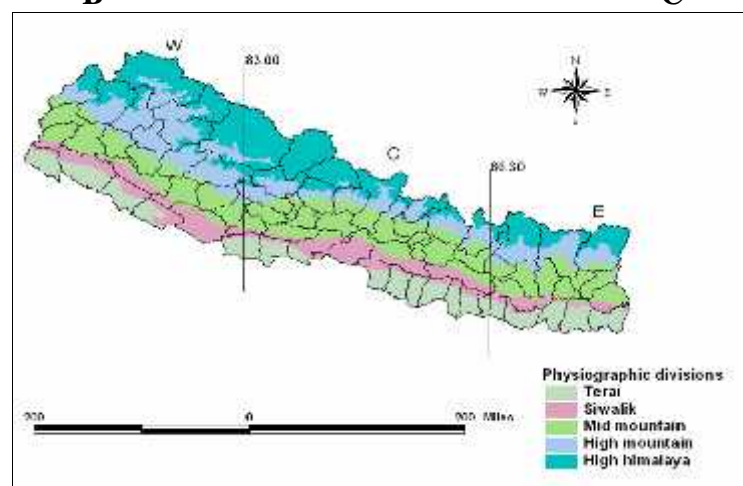
A



B



C



D

Fig. 27. *Murdannia nudiflora* (L.) Brenan.; A. Illustration: a Habit Sketch, b., Sepal, c. Petals, d. Stamen, e. Carpel, f. Seed (J.P. Gajurel 275); B. Inflorescence; C. Flower; D. Distribution map.

Specimens examined

Western Nepal: Banke, grassland near buspark, 200m, 1981.09.14, Bhattacharaya 3788 (KATH). Nepaljung, rice field, 200m, 1972.11.21, N. P. Manandhar 15005 (KATH).

Central Nepal: Kathmandu, Maithan, Sankhu, 1450m, 2006.09.14, J.P. Gajurel 211 (TUCH, KATH). Kirtipur Behind Nepali Dept., 1320m, 2006.08.14, J.P. Gajurel, Coll. No.: 120 (TUCH, KATH). Lalitpur, Tikabhairab to Chapagaoun, 1550m, 2006.10.07, J. P. Gajurel *et al.* 247 (TUCH, KATH), Kavre, From Phedi to Namobuddha, 1650m, 2006.10.04, J. P. Gajurel *et al.* 232 (TUCH, KATH). Panauti riverside, 1500m, 2006.08.26, J.P. Gajurel 159 (TUCH, KATH).

Eastern Nepal: Jhapa, Garamuni, 100m, 2006.10.26, J.P. Gajurel, 275 (TUCH, KATH).

5.9 *Murdannia spirata* (L.) Bruckn., Engler & Prantl, Nat. Pflanzenfam., ed. 2, 15a: 173. 1930. Hara, Enum. Fl. Pl. Nep. 1: 83. 1978. Noltie, Fl. Bhu. 3 (1): 229. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 48. 2000. Deyuan and DeFilipps, Fl. Ch. 24: 29. 2000.

Type: *Commelina spirata* L., Mantissa Plantarum 2: 176-177. 1771.

Commelina spirata L., Mantissa Plantarum 2: 176-177. 1771 (Hara, Enum. Fl. Pl. Nep. 1: 83. 1978).

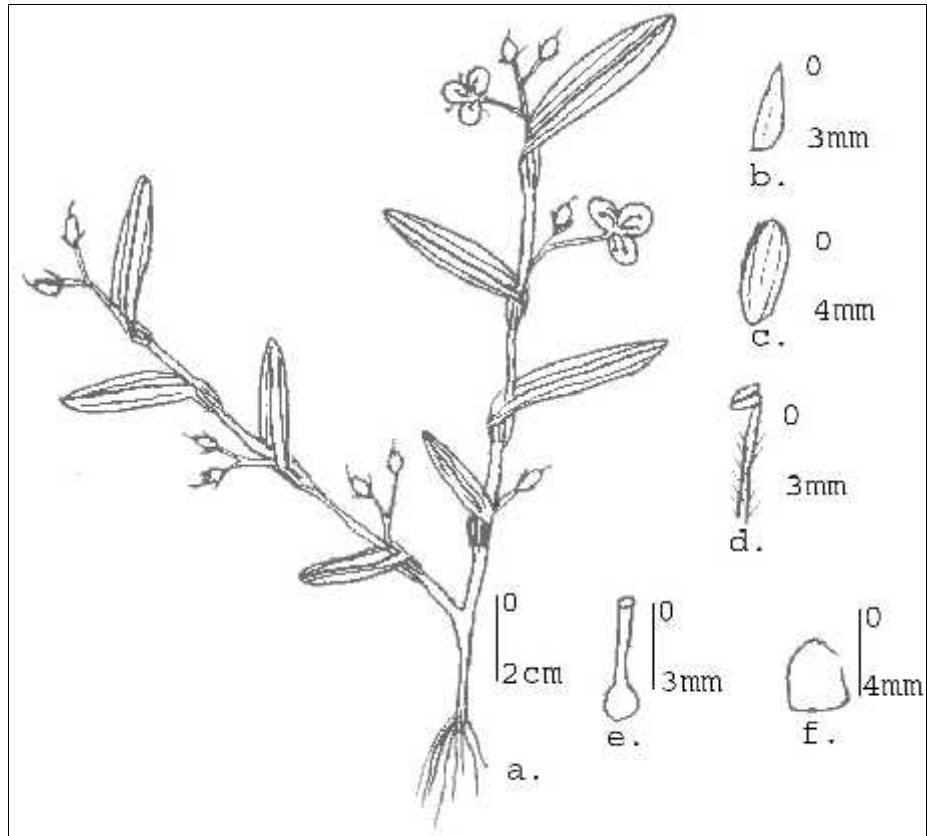
Aneilema spiratum (L.) R.Br., Prodr. 271. 1810 (Hara, Enum. Fl. Pl. Nep. 1: 83. 1978).

Herbs annual, 11-29cm. *Root* fibrous. *Stems* decumbent. *Leaves* alternate, 1--5 × 0.5--0.8 cm, linear, lanceolate to ovate, acute, glabrous, sheath ciliate at apex. *Inflorescence* terminal and axillary cyme, cincinni 1--4. *Flowers* bisexual and male. *Sepals* 3, 0.3 -- 0.6 cm, elliptic, persistent. *Petals* 3, 0.5 -- 0.8 cm, obovate-orbicular, pale blue. *Carpel* green, style straight. *Stamens* 3, filament hairy, anthers pale yellow, staminodes 3, white. *Capsules* oblong, trigonous, *Seeds* 3--7 per valve, verrucose. Fl. Jan--Dec. Fr. Nov--Dec. (fig. 28).

Ecology: Grow near sandy or muddy soil.

Distribution: Nepal (CE), (100-) 550-1800 (-1900) m, Himalaya, India, east to China, Taiwan, Malaysia.

Note: The leaves are ovate and the sheaths are ciliate. These are among some characteristic features. During the study, the specimens of this plant has been recorded from 100-1900m altitude. The flowering time is usually 8am to 12pm.



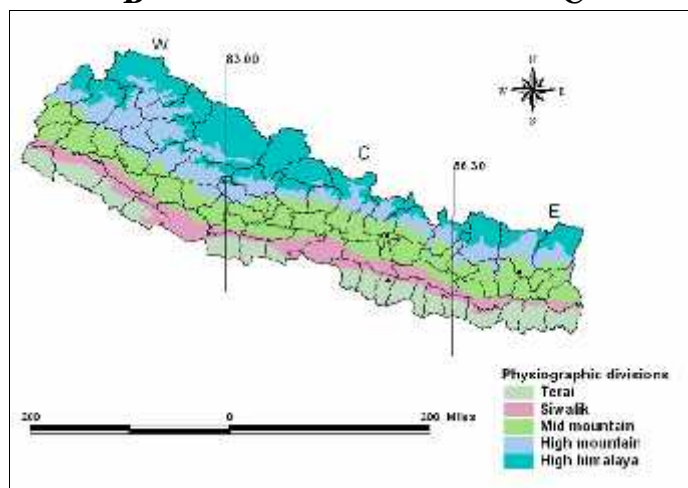
A



B



C



D

Fig. 28. *Murdannia spirata* (L.) Bruckn.; A. Illustration: a Habit Sketch, b. Sepal, c. Petals, d. Stamen, e. Carpel, f. Seed (J.P. Gajurel 212); B. Inflorescence; C. Flower; D. Distribution map.

Specimens examined:

Central Nepal: Kathmandu, Kirtipur, Bista gaon to Tindevi temple, 1550m, 2006.08.16, J.P. Gajurel *et al.* 127 (TUCH, KATH). Bhudhanilkhanta to Shivapuri, 1900m, 2006.09.01, J.P. Gajurel 181 (TUCH, KATH). Maithan, Sankhu, 1450m, 2006.09.14, J.P. Gajurel 212 (TUCH, KATH). **Bhaktapur**, Way to Changanarayan, 1600m, 2006.10.13, J.P. Gajurel, Coll. No.: 256 (TUCH, KATH).

Eastern Nepal: Rauthat, Amlekhjung, 120m, 2006.10.25, J.P. Gajurel 273 (TUCH, KATH). **Sankhuwasaba**, near bank of river, 1400m, 1991.10.16, D.G. Long *et al.* 840 (TUCH, KATH).

Key to the variety of *Murdannia spirata*

- 1.a. Petals with light mid vein, stamen dimorphism present
..... *Murdannia spirata* var. *spirata*
- 1.b. Petals with dark mid vein, stamen dimorphism absent *M. spirata* var. *parviflora*

5.9.1 *Murdannia spirata* (L.) Bruckn. var. *parviflora* Faden, Novon 11: 22-30. 2001.

Type: Sri Lanka (Faden, Rev. Handb. Fl. Cey. 4: 161. 2000).

Herbs annual. *Root* fibrous. *Stems* decumbent. *Leaves* alternate, 1--4 × 0.5--1 cm lanceolate-elliptic to ovate, rarely conduplicate, glabrous. *Inflorescence* terminal, cincinni 1--2. *Flowers* bisexual. *Sepals* 3, 2--3 mm, elliptic, persistent. *Petals* 3, 3--4 mm, dark coloured mid veins, obovate, blue. *Carpel* green, 3--4 mm, style straight. *Stamens* 6, 4--5 mm, not dimorphic in colour of anther, filaments pubescent, staminodes 3. *Capsules* oblong. Fl. Jul--Aug. Fr. Sept--Dec. (fig. 29).

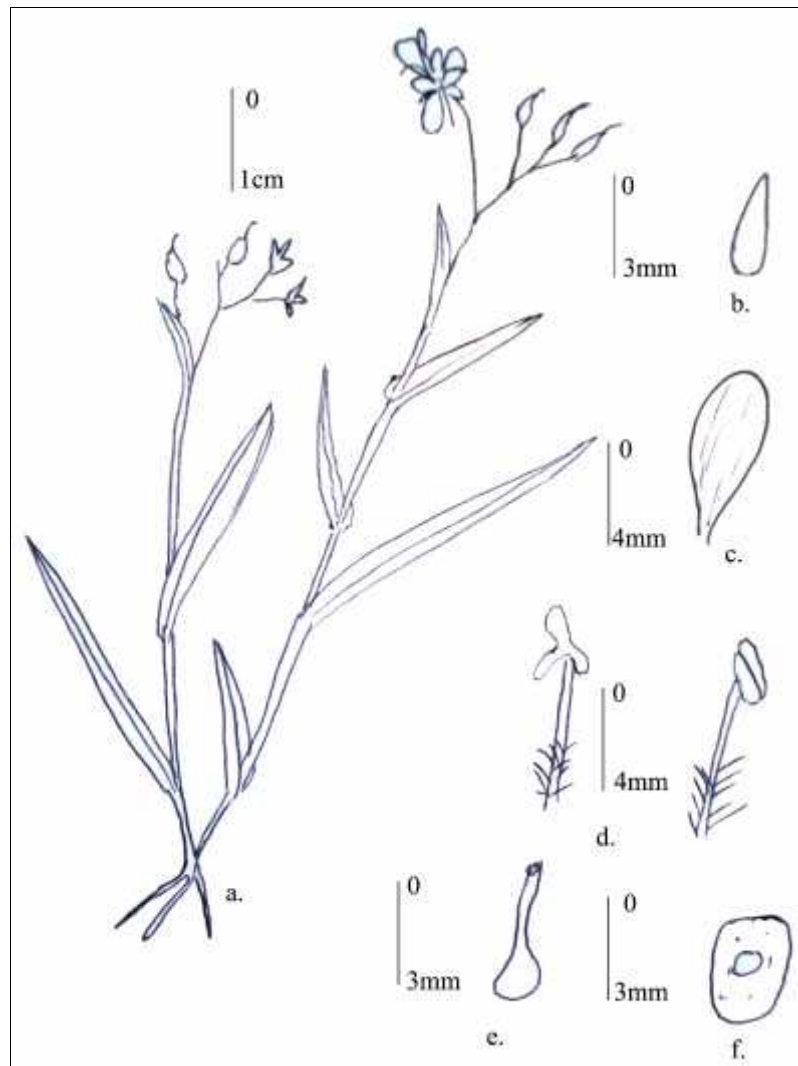
Ecology: On grassland.

Distribution: Nepal (CE), 1500-2400 m, Himalaya (Garhwal to Assam), Ceylon.

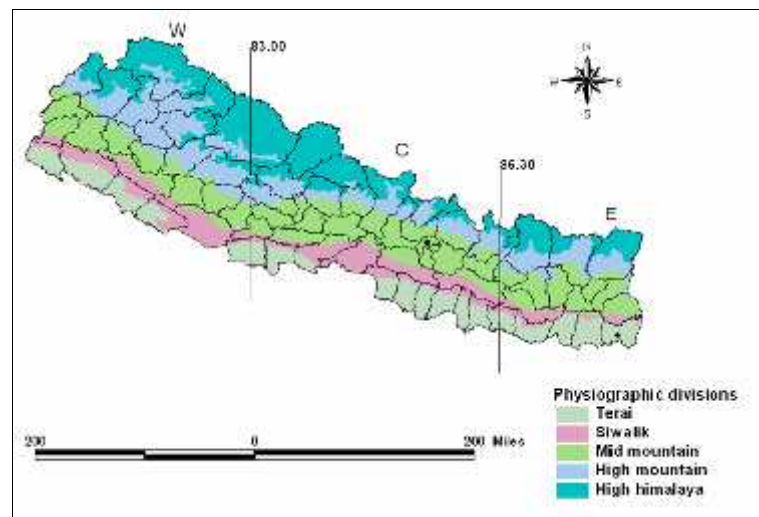
Note: This is new record for Nepal Flora. The species is distinct in having the definite base in the plant; small flowers lacking stamen dimorphism. It also differs from all other species of *Murdannia* in having less broad leaves. It need further study.

Specimens examined

Central Nepal: Kathmandu, CEDA, Kirtipur, 1340m, 2006.11.10, J.P. Gajurel, 308 (TUCH, KATH). Dakshinkali entry gate to temple, 1600-1700m, 2007.08.14, J.P. Gajurel, 316 (TUCH, KATH). Bhudhanilkhanta to Shivapuri, 1500m, 2007.08.11, J.P. Gajurel, 277 (TUCH, KATH). **Eastern Nepal: Jhapa**, Garamuni, Jhapa, 100m, 2006.10.26, J.P. Gajurel, 313 (TUCH, KATH).



A



B

Fig. 29. *Murdannia spirata* (L.) Bruckn. var. **parviflora**; A. Illustration, a. Habit Sketch, b. Sepal, c. Petal, d. Stamens, e. Carpel, f. Seed (J.P. Gajurel *et al.* 127); B. Distribution map.

Doubtful species

5.10 Murdannia vaginata (L.) Bruckn., Engler & Prantl, Nat. Pflanzenfam., ed. 2. **15a**: 173. 1930. Press *et al.*, Ann. Check. Fl. Nep. : 49. 2001. Deyuan and DeFilipps in Fl. China **24**: 28. 2000.

Type: *Commelina vaginata* L., Mant. Pl. **2**: 177. 1771.

Herbs annual, 5--60cm. *Roots* fibrous. *Rhizomes* elongate. *Stems* creeping or slightly robust, branched at base. *Leaves* alternate, 4--20 × 0.4--0.7 cm, basal to cauline, linear, glabrous, margin ciliate, sheath open. *Inflorescence* terminal or axillary cyme, cincinni 2 to many. *Flowers* bisexual 1--5, peduncle slender. *Sepals* 3, 2--5 mm, lanceolate, persistent. *Petals* 3, 2--4 mm, obovate-rhombic, blue. *Stamens* 6, fertile stamens 2, filaments pubescent, staminodes 4, antherodes 3-sect. *Carpels* 3-loculed ovary. *Capsules* stipitate, ovoid. *Seeds* 1 per valve, reticulate, hilum linear. Fl. Dec--Jan. Fr. Jan--Feb.

Ecology: Marshes and moist sandy places.

Distribution: Nepal (E), 200m, India, China, Ceylon.

Note: The specimens of this species are not deposited in the herbaria of Nepal. However, Siwakoti and Verma, D.M. mentioned this species from Nepal (Press *et al.*, 2000). It need further study.

6. POLLIA Thunb., Nov. Gen. Pl. **1**: 11. 1781.

Type: *Pollia japonica* Thunb., Flora Japonica : 138. 1784.

Herbs perennial. *Roots* fibrous. *Rhizomes* horizontal, long. *Stems* erect or ascending, Leaves usually simple, alternate, elliptic or obovate-oblongate. *Inflorescence* panicles, terminal, cincinni with several flowers. *Flowers* actinomorphic. *Sepals* 3, free, persistent, boat-shaped. *Petals* 3, free, ovate-elliptic or obovate, clawed, white, blue, purple, or greenish yellow. *Stamens* 6, all fertile, equal or 3 smaller, filaments glabrous, anther locules oblong, longitudinally dehiscent; antherodes deltoid-lanceolate or sagittate. *Carpels* 3-loculed ovary, ovules 1--10 per locule. *Capsules*

globose, 3-valved, indehiscent. *Seeds* 1--8 per valve, polygonal, hilum linear to orbicular purplish gray.

About 17 species are found in the world, in tropical, subtropical and warm temperate regions (Deyuan and DeFillip, 2000). One species of *Pollia* is found in Nepal (Press *et al.*, 2000) but it is doubtful.

Doubtful species

6.1 *Pollia hasskarlii* Hook., Fl. Brit. Ind. **3**: 289. 1896. Rao, Notes Roy. Bot. Gard. Edinburgh **25**: 188. 1964. Hara, Enum. Fl. Pl. Nep. **1**: 83 .1978. Noltie, Fl. Bhutan **3** (1): 232. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 49. 2000. Deyuan and DeFilipps, Fl. Ch. **24**: 33. 2000.

Type: *Pollia japonica* Thunb., Flora Japonica : 138. 1784.

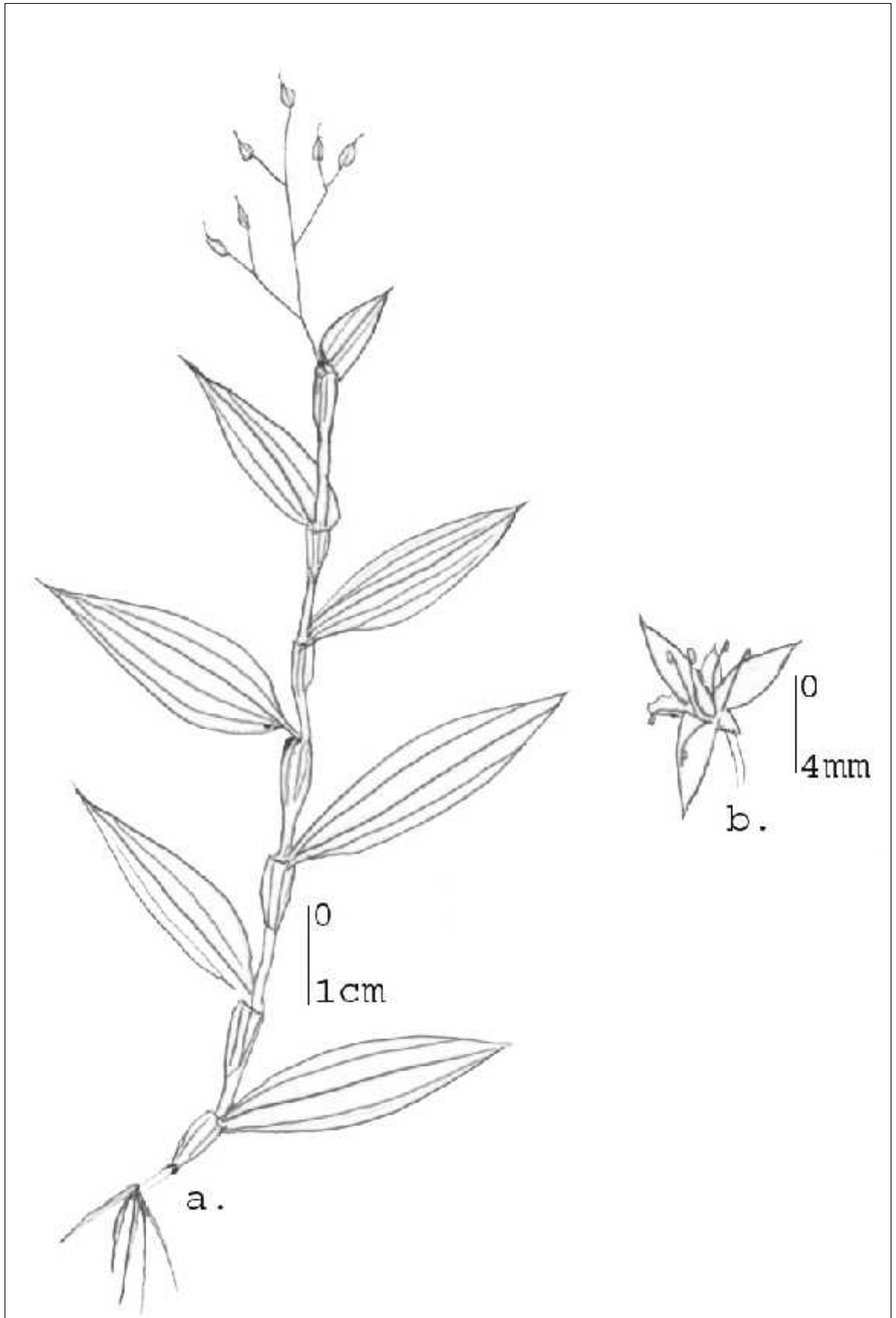
Pollia aclisia Hassk., Pl. Jungh. 1: 145. 1852 (Faden, Rev. Handb. Fl. Cey. **4**: 173. 2000).

Herbs perennial, c. 1m. *Stems* ascending, glabrous. *Leaves* alternate, 5--15 × 1--5 cm, sessile, sheath glabrous, elliptic or obovate-oblongate, glabrous on both surfaces. *Inflorescence* panicles, peduncle long, cincinni numerous, bracts membranous. *Sepals* 3, subovate, 3--4 mm, boat-shaped, caducous. *Petals* 3, obovate, 4--5 mm, white or pale purple. *Stamens* 6, fertile. *Carpels* 3-loculed ovary. *Capsules* globose. *Seeds* 3 per valve, polygonal, hilum linear. Fl. Mar--Jun. Fr. Jul--Aug. (fig. 30).

Ecology: Moist ravines, in shade.

Distribution: Nepal, Himalaya, India, Indo-China, Burma, Malaysia.

Note: A doubtful species *Pollia hasskarlii* has been reported but there is no herbarium specimen outside Nepal .The specimens of this species are not deposited in the herbaria of Nepal as well. It need further study.



A

Fig. 30. *Pollia hasskarlii* Hook.; A. Illustration: a Habit Sketch, b. Flower (Flora of China).

7. RHOPALEPHORA Hasskarl, Bot. Zeitung (Berlin). **22**: 58. 1864.

Type: *Rhopalephora micrantha* (Val) Faden. (Rev. Handb. Fl. Cey. **4**: 171. 2000).

Herbs perennial. *Roots* fibrous. *Stems* creeping proximally, ascending distally. *Leaves* distichous or spirally arranged, petiolate, leaf sheath pubescent, ovate-lanceolate. *Inflorescence* terminal and axillary thyrses, cymes elongated. *Flowers* zygomorphic. *Sepals* 3, free. *Petals* 3, free, subequal, upper 2 shortly clawed, white to lilac. *Stamens* fertile 3, filaments glabrous, staminodes 3, antherodes 2-lobed. *Carpels* 1-3 loculed ovary, ovules 1 or 2 per locule. *Capsules* subglobose, 1-3 valved, upper valve 1-seeded, indehiscent, sometimes deciduous; lower valves (when developed) seedless or 1--2 seeded, dehiscent. *Seeds* rugose, hilum linear.

About four species are found in the world, in temperate and tropical regions (Deyuan & DeFillip, 2000). One species of *Rhopalephora* is found in Nepal (Press *et al.*, 2000).

7.1 Rhopalephora scaberrima (Blume) Faden, Phytologia **37**: 480. 1977. Noltie, Fl. Bhutan **3** (1): 230. 2000. Deyuan and DeFilipps, Fl. China **24**: 35. 2000.

Type: *Commelina scaberrimum* Blume, Enum.Pl. Jav. **1**: 4. 1827.

Dictyospermum scaberrimum (Blume) J.K. Morton J. Linn. Soc., Bot. **59** (380): 435. 1966 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Aneilema protensum (Wight) Wall. ex C. B. Clarke, Enum. Pl. Zeyl, 322. 1864 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

Aneilema scaberrimum (Blume) Kunth, Enum. Pl. 4: 69. 1827 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

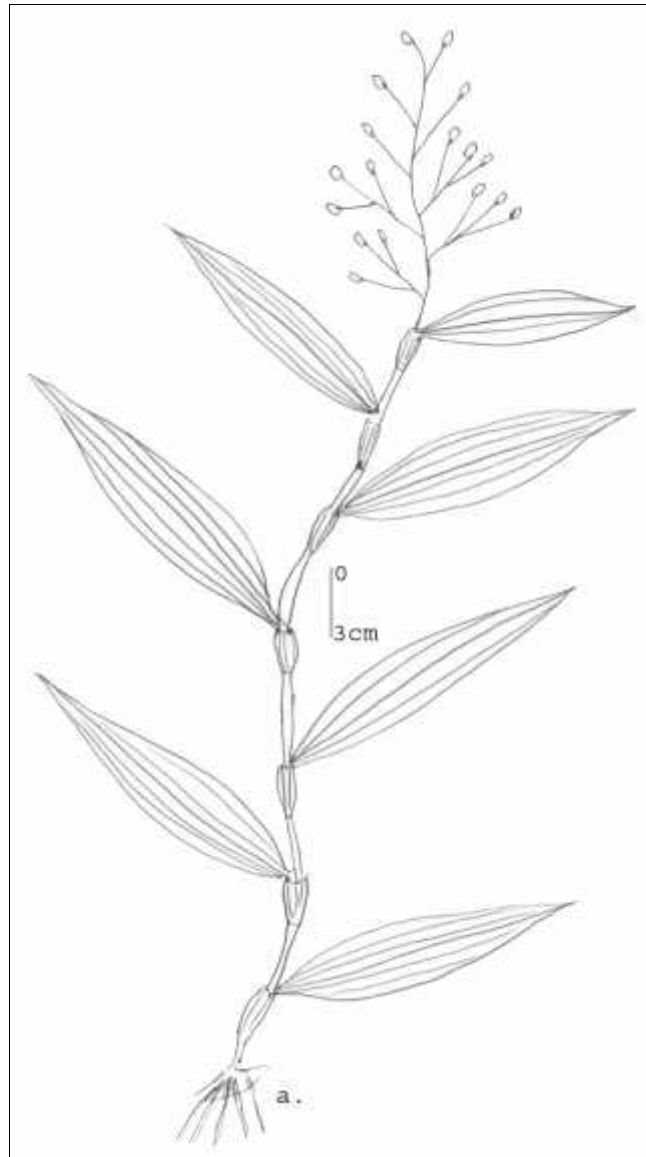
Dictyospermum protensum Wight, Ic. Pl. Ind. Or. 6: 30, t. 2071. 1853 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

Lamprodithyros protensus (Wight) Hassk., Flora 46: 389. 1864 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

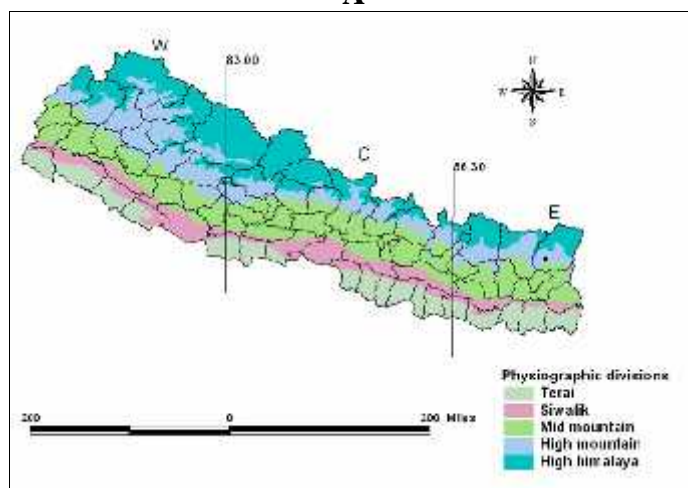
Piletocarpus protensus (Wight) Hassk., Commel. Ind. 15. 1870 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

Piletocarpus protensus var. *intermedius* Hassk., Commel. Ind. 15. 1870 (Hara, Enum. Fl. Pl. Nep. **1**: 82. 1978).

Herbs perennial, 46--47cm. *Roots* fibrous. *Stems* creeping proximally, ascending distally. *Leaves* spirally arranged, 1.5--6 x 3--13 cm, petiolate, leaf sheath pubescent, ovate-lanceolate. *Inflorescence* terminal and axillary thyrses, cymes elongated. *Flowers* zygomorphic. *Sepals* 3, 0.3--0.4 cm, free. *Petals* 3, 0.2--0.03 cm, free, sub



A



B

Fig. 31. *Rhopalephora scaberrima* (Blume) Faden; A. Illustration: a Habit Sketch (C. Grey et al. 215); 7.1.2 Distribution map.

equal, upper 2 shortly clawed, lower unclawed, white to lilac. *Stamens* 6, 3 fertile, staminodes 3, antherodes 2-lobed, filaments glabrous. *Carpels* 1--3 loculed ovary, ovules 1 or 2 per locule. *Capsules* subglobose, trilocular. *Seeds* elliptic to rectangular, hilum linear. Fl. Jul--Aug. Fr. Oct--Nov. (fig. 31).

Habitat: Found in forest bed.

Distribution: Nepal (E), 1200-2100 m, Himalaya, India, Ceylon, east to China, Taiwan, Malaysia.

Note: The specimens deposited at KATH (C. Grey-Wilson *et al.* 215) had ovate-lanceolate, cymes elongated, subequal, and Capsules subglobose, trilocular. However another specimen deposited at KATH (D.G. Long *et al.* 779), have erect, traller stem, larger alternate leaves aggregated at apex with brown sheath, terminal panicle inflorescence.

Specimen examined

Eastern Nepal: Sankhuwasaba, Near Arun river, 1500m, 1991.10.14, D.G. Long *et al.* 779 (KATH). **Taplejung**, Tamur river, 1400m, 1989.09.04, C. Grey-Wilson *et al.* 215 (KATH). **Ilam**, Chulachuli, 1400m, 1972.10.06. T.B. Shrestha and T.K. Bhattacharya 72 (KATH)

8. STREPTOLIRION Edgew. J. Proc. Linn. Soc. Lon. **1**: 254. 1845.

Type: *Streptolirion volubile* Edgew., J. Proc. Linn. Soc. Lon. **1**: 254. 1845.

Herbs perennial, climber. *Rhizomes* absent. *Stems* climber. *Leaves* alternate, petiolate, ovate-cordate, acuminate. *Inflorescences* scorpid cymes to panilce. *Flowers* actinomorphic, basal cincinnus bisexual, others male or bisexual. *Sepals* free, boat-shaped or oblong. *Petals* free, linear-spatulate, white. *Stamens* 6, fertile, equal, filaments densely pubescent, anther locules parallel, ellipsoid, longitudinally dehiscent. *Carpels* 3-loculed ovary, ovules 2 per locule. *Capsules* 3-valved, ellipsoid, beaked. *Seeds* 2 per valve, rugose, hilum linear.

One species is found in the world, in tropical and subtropical regions (Deyuan and DePhillip, 2000). One species of *Streptolirion* is found in Nepal (Press *et al.*, 2000).

8.1 Streptolirion volubile Edgew., J. Proc. Linn. Soc. Lon. **1**: 254. 1845. Hook, Fl. Brit. Ind. **6**: 285. 1896. Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978. Noltie, Fl. Bhutan **3** (1): 219. 2000. Press *et al.*, Ann. Check. Fl. Nep. : 49. 2000. Deyuan and DeFilipps in Fl. China **24**: 20. 2000.

Type: *Streptolirion volubile* Edgew., J. Proc. Linn. Soc. Lon. **1**: 254. 1845.

Streptolirion cordifolium (Griff.) Kuntze, Priv. J. 208. 1847 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

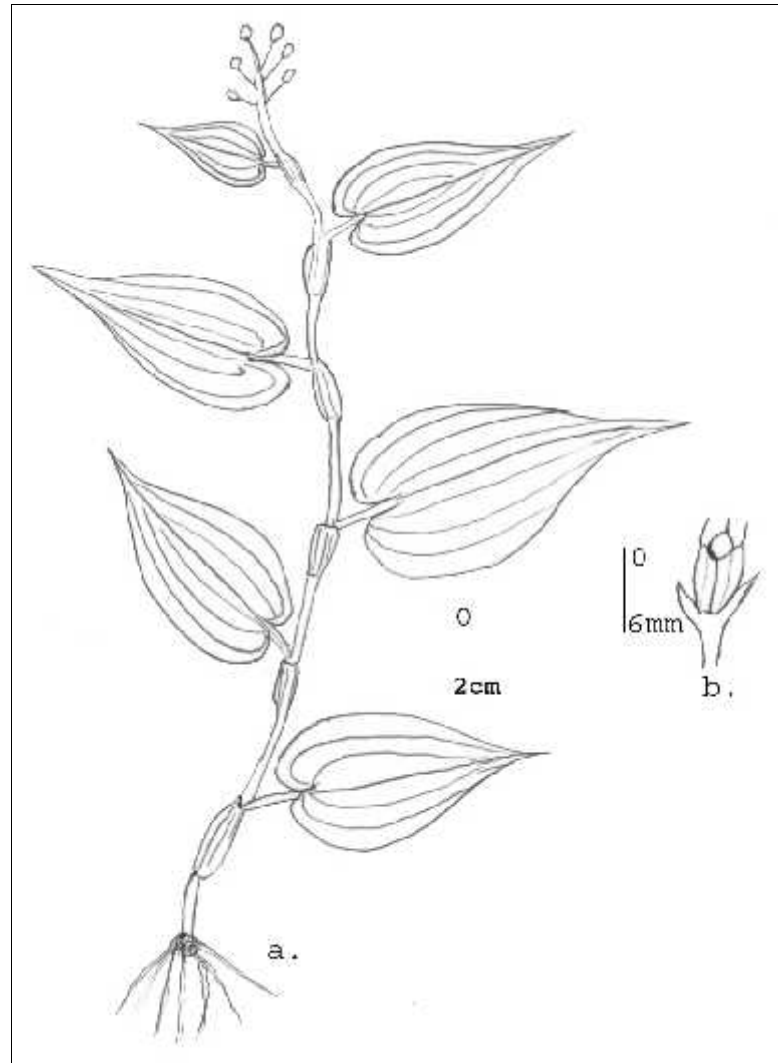
Tradescantia cordifolia (Griff.) O. Ktze., Rev. Gen. Pl. 2: 722. 1891 (Hara, Enum. Fl. Pl. Nep. **1**: 83. 1978).

Herbs perennial, climbing. *Stems* 1--6 m, glabrous. *Leaves* alternate, 3--15 × 2--5 cm, petiolate, adaxially pubescent, apex caudate, leaf blade cordate-orbicular. *Inflorescences* scorpioid cymes to panicle, pedicels absent. *Flowers* actinomorphic, basal cincinnus bisexual, others male or bisexual. *Sepals* 3, 3--5 mm, apex acute. *Petals* 3, 6--7 mm, white or pale purple, linear. *Stamens* 6, fertile, equal, filaments densely pubescent, anther locules parallel, ellipsoid, longitudinally dehiscent. *Carpels* 3-loculed ovary, ovules 2 per locule. *Capsules* beaked. *Seeds* angular, rugose, gray-brown. Fl. Jul--Aug. Fr. Sep--Oct. (fig. 32).

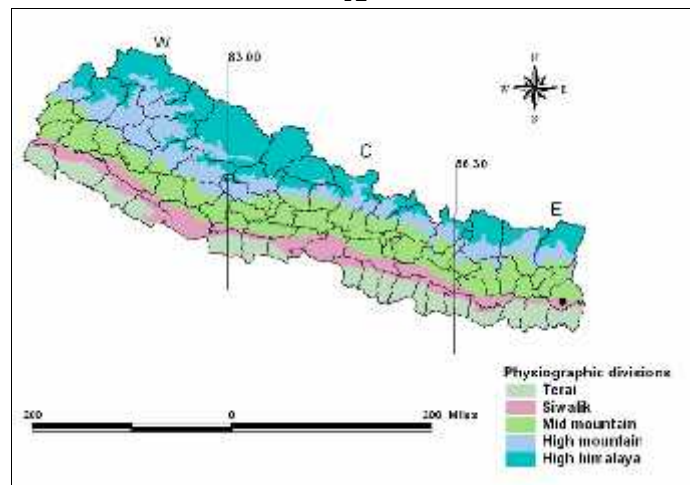
Ecology: Twining herbs on forest.

Distribution: Nepal (WE), (1200-) 1500-2400 m, Himalaya (Garhwal to Assam), China, Burma, W. Japan.

Note: The specimens of this species are not deposited in the herbaria of Nepal. The specimen has been deposited in TI collected by Hara *et al.*(6305474) from Ilam in 1963.12.04.



A



B

Fig. 32. **Streptolirion volubile** Edgew.; A. Illustration: a Habit Sketch, b. Fruit (Flora of China). B. Distribution Map.

3.3 Distribution of Commelinaceae in Nepal

The species of Commelinaceae have been recorded from Western Central and Eastern regions and from tropical to subalpine (Press *et al.*, 2000).

Table 8: Horizontal and Vertical distribution of Commelinaceae

S. N.	Species	Horizontal Distribution based on Press <i>et al.</i> 2000.	Elevation based on herbarium specimens	Horizontal Distribution based on Press <i>et al.</i> 2000.	Horizontal Distribution based on Herbarium.
1.	<i>Amischotolype hookeri</i> (Hasskarl) H. Hara.	200-800 m	1200m	E	E
2.	<i>Commelina appendiculata</i> C.B. Clarke	-	1500m	?	C
3.	<i>Commelina benghalensis</i> L.	900-1800 m	700-1700m	WCE	WCE
4.	<i>Commelina caroliniana</i> Walter	700-1400 m	100-1600m	CE	CE
5.	<i>Commelina diffusa</i> N. L. Burman	700-1300 m	160-1600m	E	CE
6.	<i>Commelina ensifolia</i> R. Br.	-	1500m	?	C
7.	<i>Commelina maculata</i> Edgew.	1600 m	700-1900m	C	CE
8.	<i>Commelina paludosa</i> Blume	300-3500 m	150-1900m	WCE	WCE
9.	<i>Commelina suffruticosa</i> Blume	150m	150m	C	C
10	<i>Cyanotis arachnoidea</i> C.B. Clarke	-	1700m	?	C
11	<i>Cyanotis axillaris</i> (L.) D. Don ex Sweet	200 m	1300-2100m	WCE	WCE
12	<i>Cyanotis cristata</i> (L.) D. Don	200-1200 m	100-1400m	CE	WCE
13	<i>Cyanotis fasciculata</i> (Hayne ex Roth) Schultes f.	1200-1900 m	1200-1900m	?	CE
14	<i>Cyanotis thwaitesii</i> Hassk.	-	1500-1600m	?	C
15	<i>Cyanotis vaga</i> (Lour.) J. A. & J. H. Schult.	800-2700 m	1400-2360m	WCE	WCE
16	<i>Floscopa scandens</i> Loureiro	550-1800 m	1000-1100m	CE	CE
17	<i>Murdannia blumei</i> (Hassk.) Brenan	1400 m	1200m	C	E
18	<i>Murdannia dimorphoides</i> Faden	-	100-1600m	?	CE
19	<i>Murdannia divergens</i> (C. B. Clarke) Bruc.	1500-2400 m	1600-1700m	WC	WC
20	<i>Murdannia edulis</i> (Stokes) Faden	180 m	2000m	WCE	WCE
21	<i>Murdannia japonica</i> (Thunb.) Faden	400-2000 m	1200m	CE	E
22	<i>Murdannia keisak</i> (Hassk.) Hand.-Mazz.	1100 m	1900m	C	C
23	<i>Murdannia medica</i> (Loureiro) D. Y. Hong	?	150	?	E
24	<i>Murdannia nudiflora</i> (L.) Brenan.	200-1500 m	100-1700m	WCE	WCE
25	<i>Murdannia spirata</i> (L.) Bruckn.	550-1800	120-1900m	CE	CE

.					
26	<i>Murdannia spirata</i> (L.) Bruckn. var. <i>parviflora</i> Faden	-	100-1700m	?	CE
27	<i>Murdannia vaginata</i> (L.) Bruckn.	200m	*	E	?
28	<i>Pollia hasskarlii</i> Hook.	?	*	?	?
29	<i>Rhopalephora scaberrima</i> (Blume) Faden	1200-2100 m	1400m	CE	E
30	<i>Streptolirion volubile</i> Edgew.	1500-2400 m	1200m	CE	E

* The specimens of the respective species are not deposited in the herbaria of Nepal; ?
No record.

Most of the species of Commelinaceae are reported from WCE. Many species are recorded in Central Nepal while least species are recorded from Western Nepal. Some species are only recorded and there is no herbarium in KATH and TUCH (*Murdannia blumei*, *M. japonica*, *M. vaginata*, *Amischotolype hookeri*, *Pollia hasskarlii* and *Streptolirion volubile*). However, there is less collection from West part.

The species recorded only from East are *Amischotolype hookeri* (Hasskarl) H. Hara and *Murdannia medica* (Loureiro) D. Y. Hong. The species which are recorded only from Central are *Commelina appendiculata* C.B. Clarke, *Commelina ensifolia* R. Br., *Commelina suffruticosa* Blume, *Cyanotis arachnoidea* C.B. Clarke, *Cyanotis thwaitesii* Hassk. and *Murdannia keisak* (Hassk.) Hand.-Mazz. However, information on collections of H. Hara *et al.* was obtained from the Flora of Nepal Database (*Murdannia blumei*, *M. japonica*, *Amischotolype hookeri* and *Streptolirion volubile*).

The herbarium specimens of *Rhopalephora scaberrima* has been obtained from East Nepal only. Among *Murdannia*, *M. vaginata* is only reported but there is no specimen to verify its distribution in Eastern Nepal. *M. japonica* and *M. blumei* have distribution only in Eastern Nepal based on herbarium studied. However, *Cyanotis cristata* is new record in Western Nepal and *Commelina diffusa* is new record in Central Nepal.

The elevation range from 180 to 3500m according to Press *et al.*, 2000. Elevation based on herbarium collected and deposited range from 100-2360m. The range of elevation in which most of the species are found is 1400-1900m.

3.4 Phenology

Flowering in most Commelinaceae is seasonal. In the tropics, it usually coincides with the rainy season, in temperate areas with the spring and summer seasons.

Table 9: Phenology of Species of Commelinaceae

S.N.	Species	Flowering	Fruiting
1.	<i>Amischotolype hookeri</i> (Hasskarl) H. Hara.	Jun--Jul	Aug--Sept
2.	<i>Commelina appendiculata</i> C.B. Clarke	Jul--Aug	Oct--Dec
3.	<i>Commelina benghalensis</i> L.	Jun--Aug	Aug--Sept
4.	<i>Commelina caroliniana</i> Walter	Jun--Aug	Aug--Sept
5.	<i>Commelina diffusa</i> N. L. Burman	May--Nov	Oct--Sep
6.	<i>Commelina ensifolia</i> R. Br.	Jul--Aug	Oct--Dec
7.	<i>Commelina maculata</i> Edgew.	Jun--Aug	Aug--Sept
8.	<i>Commelina paludosa</i> Blume	Sept--Oct	Aug--Sept
9.	<i>Commelina suffruticosa</i> Blume	Aug--Sept	Sept--Oct
10.	<i>Cyanotis arachnoidea</i> C.B. Clarke	Aug--Sept	Oct--Dec
11.	<i>Cyanotis axillaris</i> (L.) D. Don ex Sweet	Sept--Oct	Oct--Nov
12.	<i>Cyanotis cristata</i> (L.) D. Don	Jul--Aug	Sep--Oct
13.	<i>Cyanotis fasciculata</i> (Hayne ex Roth) Schultes f.	Aug--Sep	Sept--Oct
14.	<i>Cyanotis thwaitesii</i> Hassk.	Aug--Sept	Oct--Dec
15.	<i>Cyanotis vaga</i> (Lour.) J. A. & J. H. Schult.	Aug--Sept	Oct--Nov
16.	<i>Floscopa scandens</i> Loureiro	Jul--Nov	Nov--Dec
17.	<i>Murdannia blumei</i> (Hassk.) Brenan	Jan--Feb	Mar--Apr
18.	<i>Murdannia dimorphoides</i> Faden	Jul--Aug	Sep--Dec
19.	<i>Murdannia divergens</i> (C. B. Clarke) Bruc.	Jun--Sep	Aug--Sep
20.	<i>Murdannia edulis</i> (Stokes) Faden	Jun--Aug	Aug--Sept
21.	<i>Murdannia japonica</i> (Thunb.) Faden	Aug--Sep	Aug--Sep
22.	<i>Murdannia keisak</i> (Hassk.) Hand.-Mazz.	Aug--Sep	Sep--Oct
23.	<i>Murdannia medica</i> (Loureiro) D. Y. Hong	Aug--Sept	Oct--Nov
24.	<i>Murdannia nudiflora</i> (L.) Brenan.	Jun--Aug	Aug--Sept
25.	<i>Murdannia spirata</i> (L.) Bruckn.	Jan--Dec	Nov--Dec
26.	<i>Murdannia spirata</i> (L.) Bruckn. var. <i>parviflora</i> Faden	Jul--Aug	Sep--Dec
27.	<i>Murdannia vaginata</i> (L.) Bruckn.	Dec--Jan	Jan--Feb
28.	<i>Polia hasskarlii</i> Hook.	Jul--Aug	Mar--Jun
29.	<i>Rhopalephora scaberrima</i> (Blume) Faden	Jul--Aug	Oct--Nov
30.	<i>Streptolirion volubile</i> Edgew.	Jul--Aug	Sep--Oct

During study, it was found that the flowering time for most of the species of *Commelina*, *Cyanotis* and *Murdannia* were between 6am to 12am. When sunlight was more the flowers faded earlier. Regarding phenology, the flowering is usually in June--September and fruiting in October-- December. The collections were done from early July till November. It is difficult to find species in Late December till March.

3.5 Anatomical Study

The general anatomy of some species of Commelinaceae were studied. There was possible to separate the genus into different groups on the basis of anatomy of stem along with number and shape of stomata. Leaf lamina including few longitudinal veins connected by a dense system of regular transverse veins. 3-celled glandular microhairs almost invariably present. Macrohairs variable 1- or more-(usually a fixed number) celled, usually unbranched, always uniserrate.

The hypodermis is few layered sclerenchymatous and vary in different genus. Similarly, the size of the vascular bundle and size of the vessel also vary among genus but remain uninformative among species. The following are the result of anatomical study:

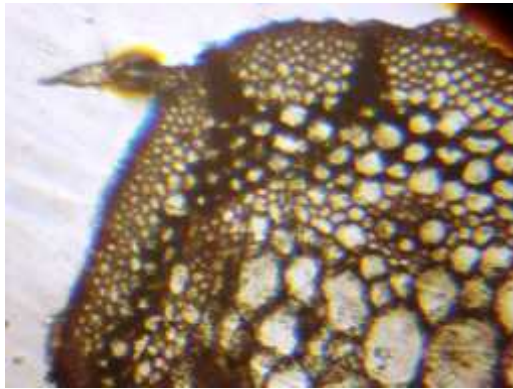
Table 10: Anatomical Study of Some Genera of Commelinaceae

S. N.	Name of the Genera	Anatomy of stem	Epidermal hair	stomata
1.	<i>Commelina</i>	Hypodermis is sclerenchymatous. Vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	3 celled hook type	6-celled, brachyparahexacytic
2.	<i>Cyanotis</i>	Hypodermis is sclerenchymatous. Vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	2 celled short type with blunt end	4-celled, paratrachytic
3.	<i>Floscopa</i>	*	2 celled, apical cell being long	6-celled brachy-parahexacytic
4.	<i>Murdannia</i>	Hypodermis is sclerenchymatous. Vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed near the pith. The metaxylems are of smaller cavity.	2 celled (apical cell being short) short type with blunt end	6- celled, brachy-parahexacytic
5.	<i>Pollia</i>	*	2 celled with narrow basal cell	stomata are 6 celled

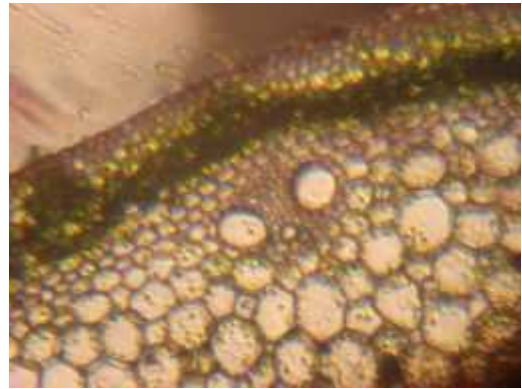
* Anatomical works not carried due to shortage of specimens.

Key to Genera based on anatomy:

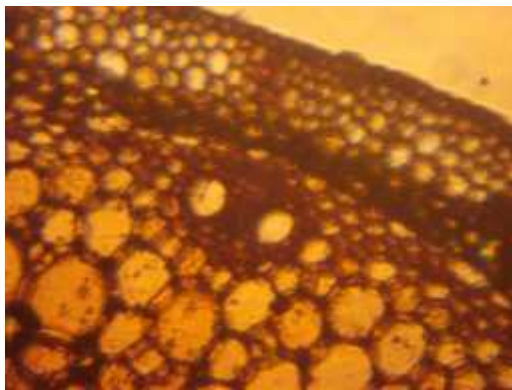
- 1.a. Stomata 6 celled2
- 1.b. Stomata 4 celled stomata*Cyanotis*
- 2.a. Epidermal hair 2-celled..... 3
- 2.b. Epidermal hairs 3-celled *Commelina*
- 3.a. Apical cells of epidermal hairs long *Floscopa*
- 3.b Apical cells of epidermal hairs short *Murdannia*



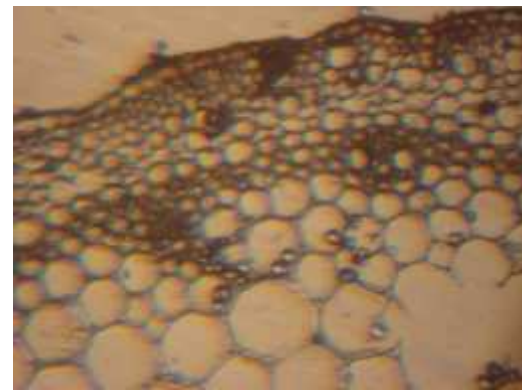
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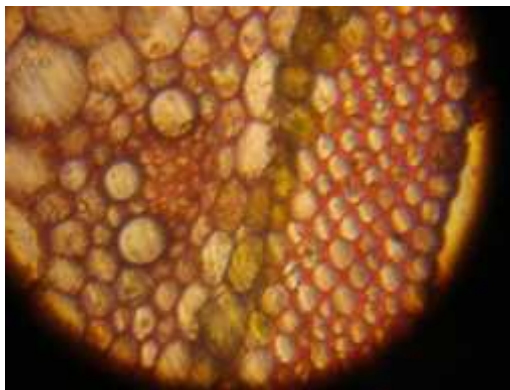
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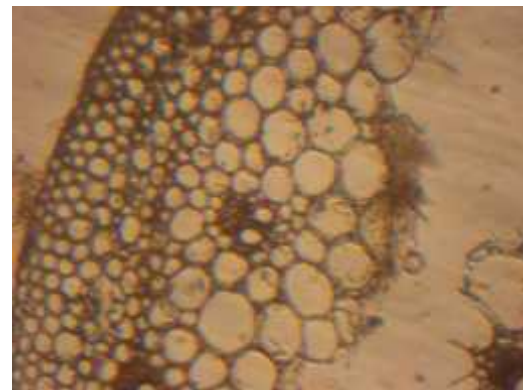
c



d

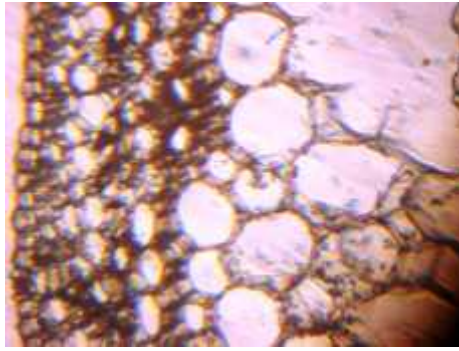


e

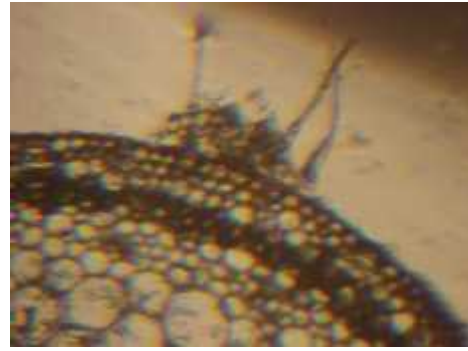


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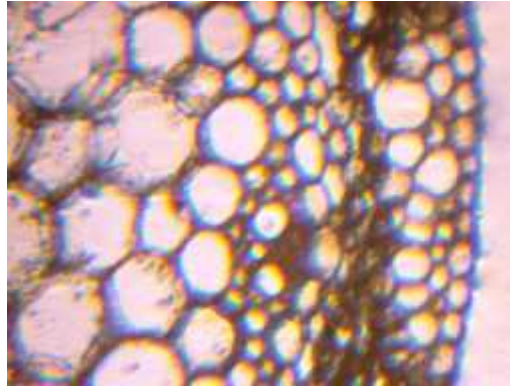
Fig. 33. T.S. of Stem type with the metaxylems larger cavity: a. *Commelina benghalensis* L., b. *C. caroliniana* Walter, c. *C. diffusa* N. L. Burman, d. *C. maculata* Edgew., e. *C. paludosa* Blume, f. *C. suffruticosa* Blume.



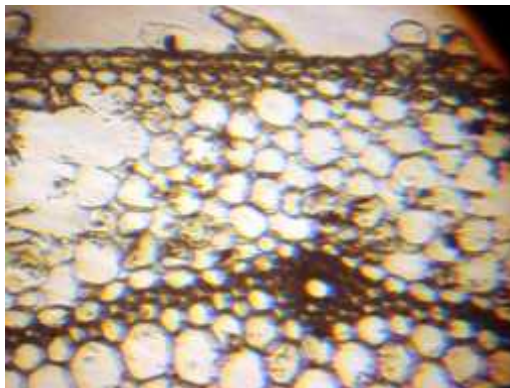
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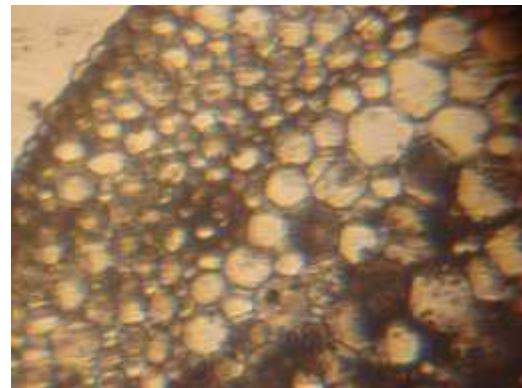
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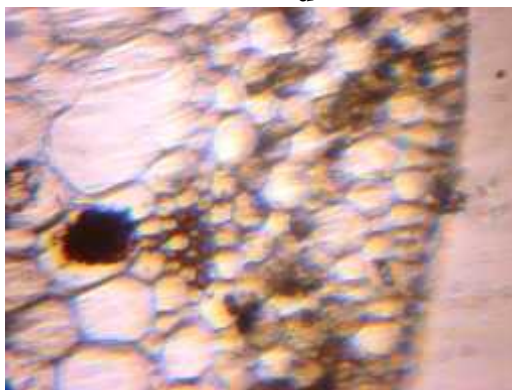
c



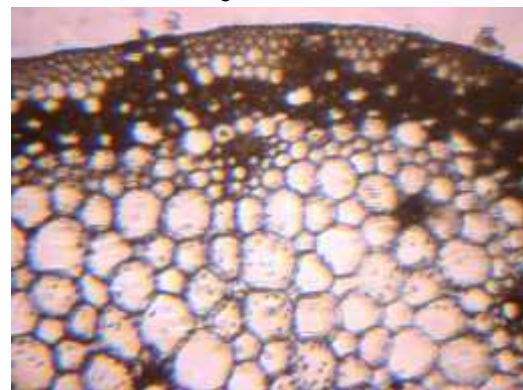
d



e



f



g

Fig. 34. **T.S. of Stem type with the metaxylems larger cavity (a-c):** a. *Cyanotis cristata* (L.) D. Don, b. *C. fasciculata*, c. *C. vaga* (Lour.) J. A. & J. H. Schult.; **T.S. of Stem type with the metaxylems smaller cavity (d-g):** d. *Murdannia divergens* (C. B. Clarke) Bruc., e. *M. keisak* (Hassk.) Hand.-Mazz, f. *M. nudiflora* (L.) Brenan, g. *M. spirata* (L.) Bruckn.

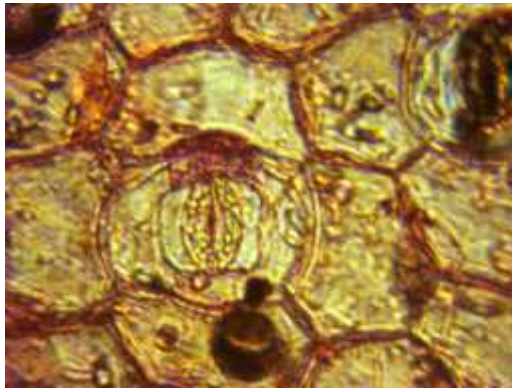
3.5.1 Commelina (Type 1)

In the anatomy of stem, the epidermal hairs are 3 celled hook type with pointed end. The hypodermis is few layered sclerenchymatous. The vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.

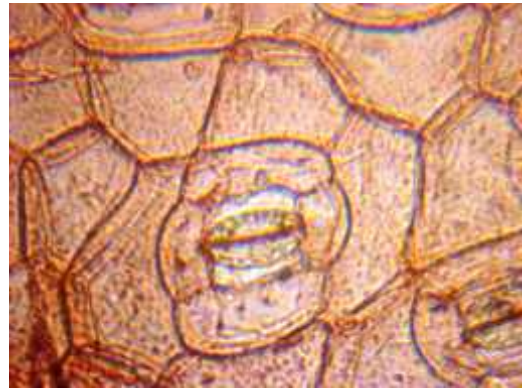
The stomata are 6 celled, brachyparhexacytic. This feature matches the findings of Tomlinson (1966). The shape of the stomata due to arrangement of 6 cells is either circular (*C. benghalensis*, *C. maculata*, and *C. suffruticosa*) or rectangular (*C. diffusa* and *C. caroliniana*).

Table 11: Anatomical Study of Species of Commelina

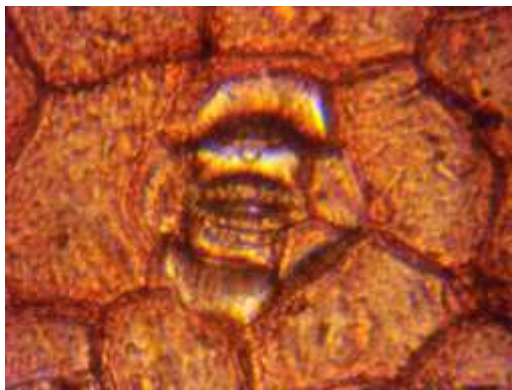
S. N.	Name of the Genera	Anatomy	Epidermal hair	Stomata
1.	<i>Commelina benghalensis</i> L.	Hypodermis is sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	3 celled hook type	6 celled, brachyparhexacytic, arrangement of 6 cells circular
2.	<i>Commelina diffusa</i> N. L. Burman	Hypodermis is sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	3 celled hook type	6 celled, brachyparhexacytic, arrangement of 6 cells rectangular
3.	<i>Commelina caroliniana</i> Walter	Hypodermis is sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity	3 celled hook type	6 celled, brachyparhexacytic, arrangement of 6 cells rectangular
4.	<i>Commelina maculata</i> Edgew.	Hypodermis sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	3 celled hook type	6 celled, brachyparhexacytic, arrangement of 6 cells circular
5.	<i>Commelina paludosa</i> Blume	Hypodermis sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	3 celled hook type	6 celled, brachyparhexacytic, arrangement of 6 cells rectangular
6.	<i>Commelina suffruticosa</i> Blume	Hypodermis sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	3 celled hook type	6 celled, brachyparhexacytic, arrangement of 6 cells circular



a



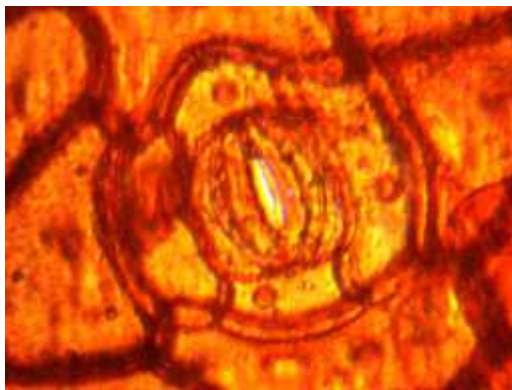
b



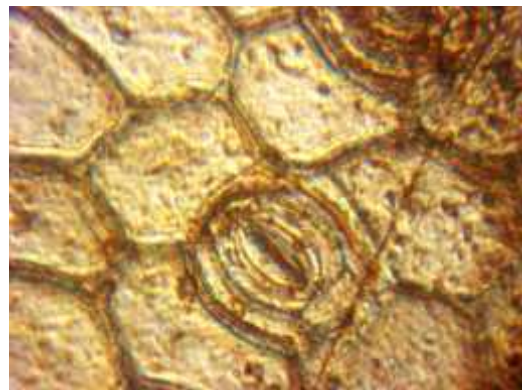
c



d



e



f

Fig. 35. Stomata type 1 with 6 subsidiary cells: a. *Commelina benghalensis* L., b. *C. caroliniana* Walter, c. *C. diffusa* N. L. Burman, d. *C. maculata* Edgew., e. *C. paludosa* Blume, f. *C. suffruticosa* Blume.

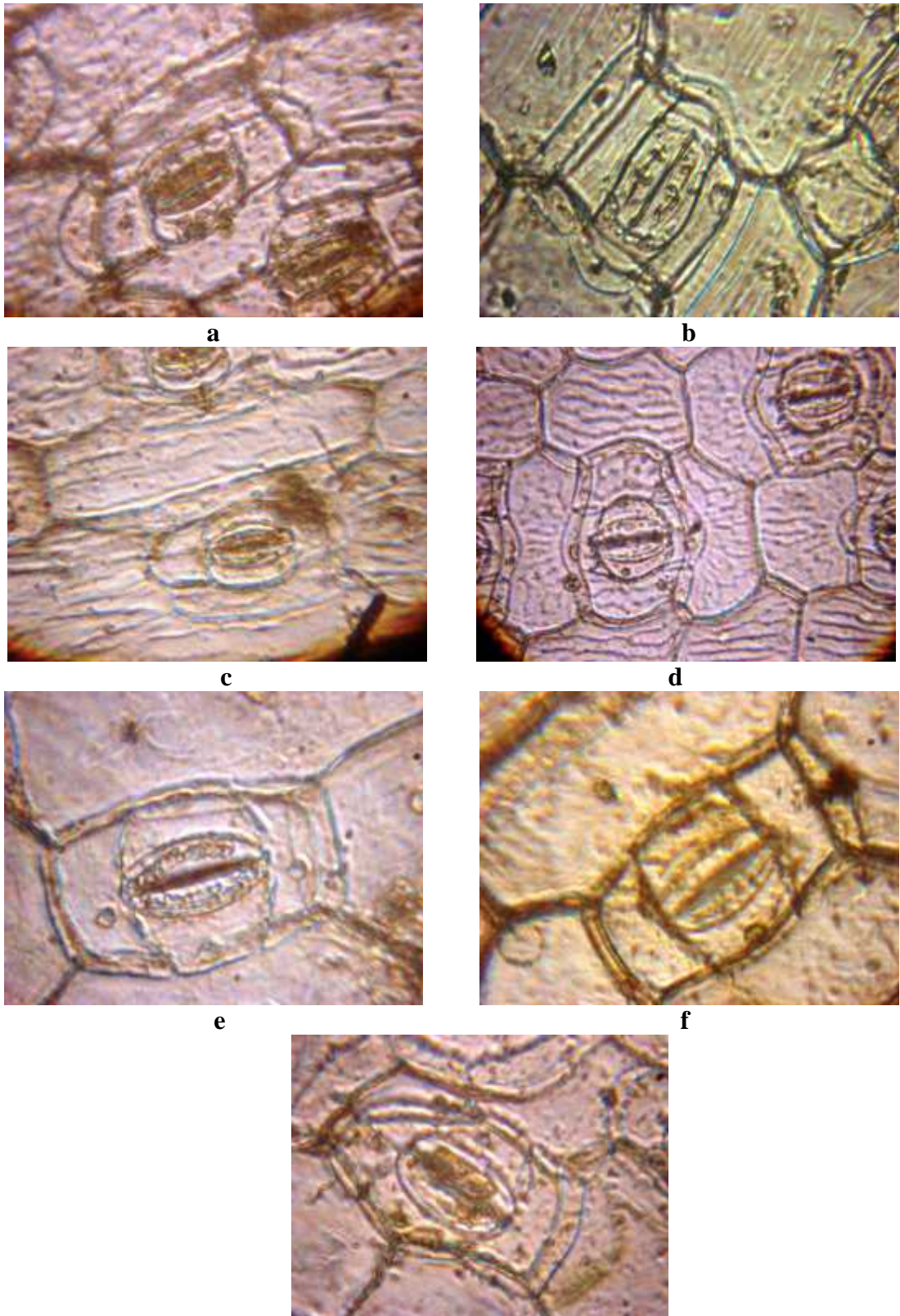


Fig. 36. **Stomata type 1 with 6 subsidiary cells (a-d):** a. *Murdannia divergens* (C. B. Clarke) Bruc., b. *M. keisak* (Hassk.) Hand.-Mazz, c. *M. nudiflora* (L.) Brenan., d. *M. spirata* (L.) Bruckn.; **Stomata type 2 with 4 subsidiary cells (e-g):** e. *Cyanotis cristata* (L.) D. Don, f. *C. fasciculata* (Hayne ex Roth) Schultes f., g. *C. vaga* (Lour.) J. A. & J. H. Schult.

3.5.2 *Murdannia* (Type 1 based on stomata)

In the anatomy of stem, the epidermal hairs are 2 celled (apical cell being short) short type with blunt end. The hypodermis is few layered sclerenchymatous. The vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed near the pith. The metaxylems are of smaller cavity.

The stomata are 6 celled, brachyparahexacytic. This feature matches the findings of Tomlinson (1966). The shape of the stomata due to arrangement of 4 cells is rectangular but the marginal cells are also elongated in *M spirata*, *M. nudiflora*, *M. divergens*.

Table 12: Anatomical Study of Species of *Murdannia*

S. N.	Name of the Genera	Anatomy	Epidermal hair	Stomata
1.	<i>Murdannia blumei</i> (Hassk.) Brenan *	Hypodermis sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed near the pith. The metaxylems are of smaller cavity.	2 celled (apical cell being short) short type with blunt end	6-celled, shape is 4 cells is rectangular
2.	<i>Murdannia divergens</i> (C. B. Clarke) Bruc.	Hypodermis sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed near the pith. The metaxylems are of smaller cavity.	2 celled (apical cell being short) short type with blunt end	6-celled, shape is elongated
4.	<i>Murdannia keisak</i> (Hassk.) Hand.-Mazz.	Hypodermis sclerenchymatous vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed near the pith. The metaxylems are of smaller cavity.	2 celled (apical cell being short) short type with blunt end	6-celled, shape is 4 cells is rectangular
5.	<i>Murdannia nudiflora</i> (L.) Brenan.	Hypodermis sclerenchymatous vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed near the pith. The metaxylems are of smaller cavity.	2 celled (apical cell being short) short type with blunt end	6 celled, shape is elongated
7.	<i>Murdannia spirata</i> (L.) Bruckn.	Hypodermis sclerenchymatous vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed near the pith. The metaxylems are of smaller cavity.	2 celled (apical cell being short) short type with blunt end	6 celled, shape is elongated

* Based on Tomlinson (1966).

3.5.3 *Cyanotis* (Type 2 based on stomata)

In the anatomy of stem, the epidermal hairs are 2 celled short type with blunt end. The hypodermis is few layered sclerenchymatous. The vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The

metaxylems are of larger cavity than that of *Murdannia* but smaller than that of *Commelina*.

The stomata are 4 celled, paratetracytic. This feature matches the findings of Tomlinson (1966). The shape of the stomata due to arrangement of 4 cells is rectangular but the marginal cells are square. The shape and arrangement of stomata and other anatomical features in *C. vaga*, *C. fasciculata* and *C. cristata* did not vary during the study.

Table 13: Anatomical Study of Species of Cyanotis

S. N.	Name of the Genera	Anatomy	Epidermal hair	Stomata
1.	<i>Cyanotis cristata</i> (L.) D. Don	Hypodermis sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	2 celled short type with blunt end	4-celled, paratetracytic.
2.	<i>Cyanotis fasciculata</i> (Hayne ex Roth) Schultes f.	hypodermis sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	2 celled short type with blunt end	4-celled, paratetracytic
3.	<i>Cyanotis vaga</i> (Lour.) J. A. & J. H. Schult.	Hypodermis sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	2 celled short type with blunt end	4 celled, paratetracytic
4.	<i>Cyanotis axillaris</i> (L.) D. Don ex Sweet*	Hypodermis sclerenchymatous, vascular bundles are conjoint, collateral, endarch and closed, large in size and are distributed away from the pith. The metaxylems are of larger cavity.	2 celled short type with blunt end	4 celled, paratetracytic

* Based on Tomlinson (1966).

3.5.4 Floscopa

The epidermal hairs are short, two celled, apical cell being long and stomata are 6 celled (Tomlinson 1966).

3.5.5 Pollia

The epidermal hairs are short, 2 celled with narrow basal cell and stomata are 6 celled (Tomlinson 1966).

The further study in different species was not possible due to shortage of specimens.

3.6 Pollen Analysis

The pollen is very variable in size between and to a limited extend, within genera. Pollen evidence can be valuable in solving problems of classification at tribal and subtribal levels.

Pollen grains in family Commelinaceae are single, heteropolar and monosulcate, although some variation can be seen This feature matches with the findings of Hunt and Poole (1979).

Table 14: Pollen Analysis of Some Genera of Commelinaceae

S.N.	Name of the Genera	Tectum	sulcus
1.	<i>Commelina</i>	perforate	spinolate
2.	<i>Cyanotis</i>	regulate	Coarse granular
3.	<i>Murdannia</i>	perforate	tuberculate

Key to genera (whose pollen where studied):

- 1.a. Tectum perforate.....2
 1.b. Tectum regulate *Cyanotis*
 2.a. Sulcus spinolate *Commelina*
 2.b. Sulcus tuberculate *Murdannia*

However, due to very inconvenient microscope, it was possible to obtain following results in some available species of Commelinaceae. The surface and the shape of the pollen is very interesting when studied in 1000X magnification. As there was no acetic acid, a new method has given promising result. According to the result obtained from pollen analysis:

3.6.1 Commelina: Tectum perforate, irregularly spaced. Spinulae closer towards transitional zone. Sulcus spinolate. This feature matches with the findings of Hunt and Poole (1979).

Table 15: Pollen Analysis of Species of Commelina

S.N.	Name of the Genera	Shape	Tectum and Sulcus
1.	<i>Commelina benghalensis</i> L.	Kidney shape (Type 1)	Perforate and Spinolate
2.	<i>Commelina diffusa</i> N. L. Burman	Oval (Type 3)	Perforate and Spinolate
3.	<i>Commelina caroliniana</i> Walter	Oval (Type 3)	Perforate and Spinolate
4.	<i>Commelina maculata</i> Edgew.	Oval (Type 3)	Perforate and Spinolate
5.	<i>Commelina paludosa</i> Blume	Circular (Type 2)	Perforate and Spinolate

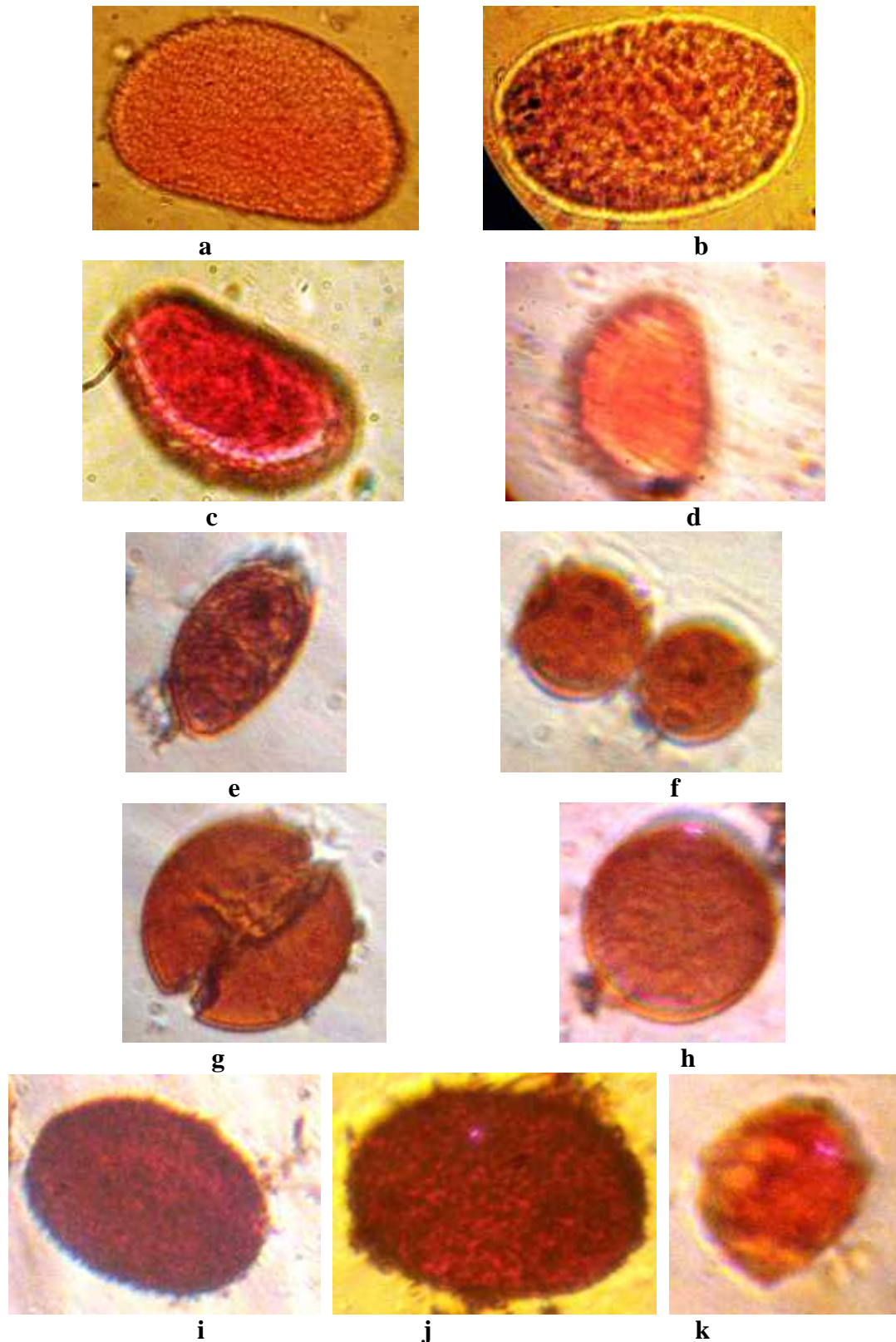


Fig. 37. **Pollen Type 1 with kidney shape (a-e):** a. *Commelina benghalensis* L., b. *Cyanotis cristata* (L.) D. Don, c. *C. vaga* (Lour.) J. A. & J. H. Schult., d. *Murdannia keisak* (Hassk.) Hand.-Mazz., e. *M. nudiflora* (L.) Brenan.; **Pollen Type 2 with circular shape (f-h):** f. *C. paludosa* Blume, g. *Cyanotis fasciculata* (Hayne ex Roth) Schultes f., h. *Murdannia spirata*, **Pollen Type 3 with oval shape (i-k):** i. *C. caroliniana* Walter, j. *C. diffusa* N. L. Burman, k. *C. maculata* Edgew.

3.6.2 Cyanotis: Tectum regulate. Sulcus membrane coarse granular.

Table 16: Pollen Analysis of Species of Cyanotis

S.N.	Name of the Genera	Outline of pollen	Tectum and Sulcus
1.	<i>Cyanotis cristata</i> (L.) D. Don	Circular(Type 2)	Regulate and coarse granular
2.	<i>Cyanotis fasciculata</i> (Hayne ex Roth) Schultes f.	Kidney shape(Type 1)	Regulate and coarse granular
3.	<i>Cyanotis vaga</i> (Lour.) J. A. & J. H. Schult.	Kidney shape(Type 1)	Regulate and coarse granular

3.6.3 Murdannia: Tectum perforate, regularly spaces. Tuberculae noticeable closer towards transitional zone. Sulcus membrane tuberculate. This feature matches with the findings of Hunt and Poole (1979).

Table 17: Pollen Analysis Species of Murdannia

S.N.	Name of the Genera	Outline of pollen	Tectum and Sulcus
1.	<i>Murdannia keisak</i> (Hassk.) Hand.-Mazz.	Kidney shaped (Type 1)	Perforate and tuberculate
2.	<i>Murdannia nudiflora</i> (L.) Brenan.	Kidney shaped (Type 1)	Perforate and tuberculate
3.	<i>Murdannia spirata</i> (L.) Bruckn.	Circular (Type 2)	Perforate and tuberculate

The further study in different species was also done but the characterization of pollen was not distinct in 1000X. The result would have been more interesting in presence of Scanning Electron Microscope.

3.7 Phytochemical Tests

The phytochemical analysis of *Cyanosis* (*C. vaga*), *Murdannia* (*M. nudiflora*) and *Commelina* (*C. benghalensis* and *C. maculata*) were done.

Table 18: Phytochemistry of Some Species of Commelinaceae

S. N.	Species	Saponin Test	Reducing Sugar test	Alkaloid Test	Flavonoid Test	Quinone Test
1.	<i>Commelina benghalensis</i> L.	Negative	Positive	Positive	Negative	Positive
2.	<i>Commelina maculata</i> Edgew.	Negative	Positive	Positive	Negative	Positive
3.	<i>Commelina paludosa</i> Blume	Negative	Positive	Positive	Negative	Positive
4.	<i>Murdannia nudiflora</i> (L.) Brenan.	Negative	Negative	Positive	Negative	Positive
5.	<i>Cyanotis vaga</i> (Lour.) J. A. & J. H. Schult.	Negative	Negative	Positive	Negative	Positive

From the phytochemical tests, some species of *Commelina* (*C. benghalensis* and *C. maculata*) showed the presence of reducing sugar while the species of *Cyanosis* (*C. vaga*) and *Murdannia* (*M. nudiflora*) showed absence of reducing sugar.

Similarly, Saponin test was negative in *Commelina* (*C. benghalensis* and *C. maculata*), *Cyanosis* (*C. vaga*) and *Murdannia* (*M. nudiflora*), which matched with the finding of Faden (1985).

Flavonoid test was also negative in *Commelina* (*C. benghalensis* and *C. maculata*), *Cyanosis* (*C. vaga*) and *Murdannia* (*M. nudiflora*), which do not agree with Faden (2000). The presence of alkaloid in *Commelina*, *Cyanotis* and *Murdannia* agrees with Faden (1985).

Presence of quinone in some species of *Commelina* (*C. benghalensis* and *C. maculata*), *Cyanosis* (*C. vaga*) and *Murdannia* (*M. nudiflora*) aids the antimicrobial activity of these plants.

3.8 Cluster analysis

The dendrogram obtained from the analysis of the data (SPSS 11) is given below:

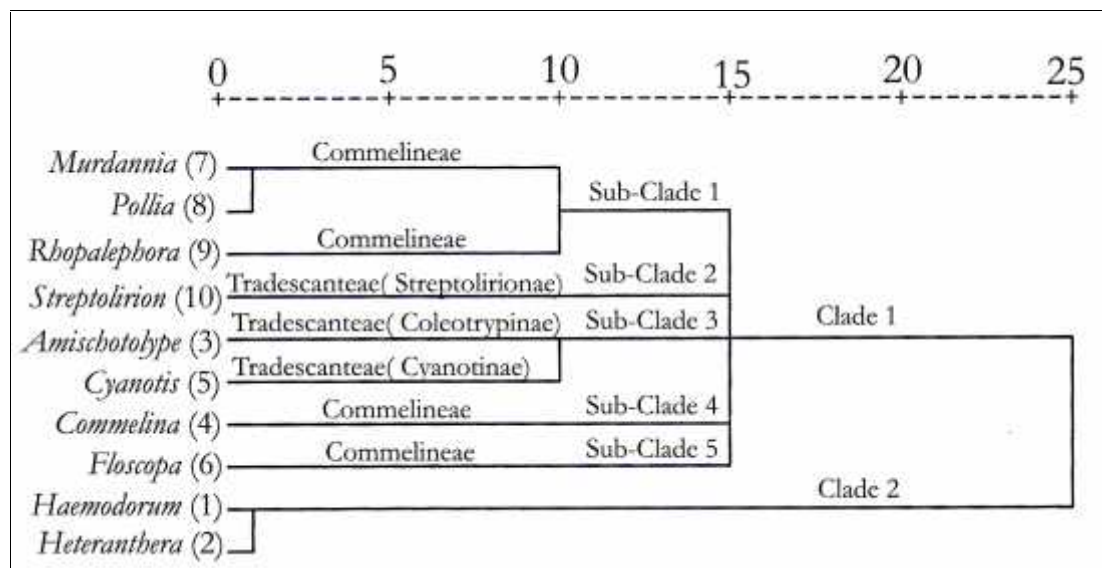


Fig 38. Dendrogram of Genera of Commelinaceae in Nepal.

From the cluster analysis, it is clear that genera *Haemodorum* and *Heteranthera* are not the member of the family Commelinaceae and are the outgroups. Out of 10 genera, 8 genera belong to clade 1 (Commelinaceae) and 2 genera belong to clade 2. The clade 1 of family Commelinaceae can be further be divided into 5 sub-clades. Sub-clade 1, 4 and 5 represented tribe Commelineae. The tribe Tradescanteae is represented by sub-clades 2 and 3.

The sub-clade 1 is branched into two groups consisting *Rhopalephora* on one side and *Murdannia* along with *Pollia* on the other side. Similarly, *Commelina* and *Floscopa* come in sub-clade 4 and sub-clade 5 respectively.

The *Streptolirion* is in sub-clade 2 within tribe Tradescanteae. Similarly, sub-clade 5 is branched and consist of *Cyanotis* and *Amischotolype*.

CHAPTER IV DISCUSSION AND CONCLUSION

4.1 Discussion

There is natural division of the taxa between Old and the New World. The seven subtribes of the tribe Tradescantieae are each, wholly confined either to the Eastern or the Western hemisphere, whereas the tribe Commelinaceae is found mainly in Africa and Asia (Faden and Hunt 1991). Commelinaceae is a medium sized family with about 41 genera and 650 species worldwide (Kubitzia, 1998). The genera are largely tropical and subtropical but extend into temperate regions, and the greatest diversity is in Africa (Faden 1983).

In *Commelina benghalensis*, *C. maculata* and *C. paludosa* the spathe is funnel form. Dense hairs are present on the spathe in the *C. maculata* and *C. benghalensis*. The colours of the hairs are also vary among the specimens collected from different places. The colour ranges from reddish brown to slightly brown. In *C. benghalensis* the spathe are sub sessile and the margins are long. The spathe of the *C. paludosa* have apex acute and is glabrous.

There is distinct variation in the spathe among the species of *Commelina*. *Commelina diffusa* and *C. caroliniana* have long solitary spathe with apex acuminate and base cordate. The margins are free and the surface is glabrous. In *Commelina suffruticosa*, the spathe is ovate and clustered and dense hairs are present.

Distinguishing *Commelina diffusa* from *C. caroliniana* (*C. hasskarlii* in the older literature) is very difficult. The fruits and flowers can help in separating these two species. The fruits and seeds of *C. caroliniana* are larger than those of *C. diffusa*, and its seeds have a smooth testa, whereas those of *C. diffusa* have reticulate testa. The anthers of the staminodes in *C. diffusa* are entirely yellow, whereas those of *C. caroliniana* are purple in the center, where all of the lobes come together. Central dark spot is also present in *C. caroliniana*. This is very important character found during the study and can be a useful character to separate the species. These characters do not match with description in Flora of China and Flora of Bhutan.

The *C. maculata* with reddish brown hairs and small leaves confuse it with *C. benghalensis* but in case of *C. maculata* tuberous roots are present and this is a very useful feature to observe and record which have made it difference from *C. benghalensis*. The plants agree with those in Flora of Bhutan very well, but they are somewhat smaller than plants in Flora of China.

Some *Commelina* collections seem to best agree with *C. maculata*, but perhaps might be approaching *C. paludosa*; therefore, we can consider *C. maculata* as only a small form of *C. paludosa*. However, from specimens collected, they seem to be quite distinct. The reddish brown hairs are present on the summit of the leaf sheath in both *C. maculata* and *C. paludosa*, but the spathe of *C. maculata* is slightly hairy while that of *C. paludosa* is smooth.

From the specimens examined, *C. maculata* can be grouped into:

Group A: Those with reddish brown hairs on the summit of the sheath and the spathe, leaves slightly pubescent.....many specimens.

Group B: Those with reddish brown hairs on the summit of the sheath and the spathe including leaves. Whole plant is densely pubescent.....many specimens.

The *Commelina suffruticosa*, which have tuberous roots, blue flowers and the leaves are larger with more spathe together, does not agree with the description as in the flora of China.

During the study, it was found that *Cyanotis fasciculata* is a more slender plant than *C. vaga* and the bracteoles that cover the flowers are usually covered with a white-woolly pubescence except one specimen collected from Ilam, which is much larger than other collections and has a sparse pubescence.

In *Cyanotis vaga*, the colour of the petals in some isolated population is pink which does not agree with Flora of Bhutan as well as in Flora of China. In some localities, the number of petals is four, which is not mentioned in any literature. Such feature has been observed only in isolated population at one locality.

From the specimens examined, *C. vaga* can be grouped into:

Group A: The number of petals always 3 and colour of petals blue.....many specimens.

Group B: The number of petals always 3 and colour of petals pink.....few specimens.

Group C: The number of petals always 4 and colour of petals blue.....few specimens.

Among *Murdannia*, the species are separated by characters like presence of tuberous roots, arrangement of leaves, characters of seeds and even the inflorescence. The *Murdannia edulis* lack elongate bladeless sheaths in the inflorescence and have the persistent bractless along with glabrous pedicels, which is similar to the notes given in Flora of Bhutan. Among the specimens of the *Murdannia nudiflora*, plants which are larger in size with leaves in basal rosette forms are also observed during the study.

The roots of *M. divergens* are tuberous while rest of the species lack such roots. Another variation found during the study is the number of seeds per locules. The number ranges from 2--7. However, in *M. vaginata* has 1 seed per locule, which is not as per the description of genus.

The species of Commelinaceae in Nepal are distributed from Western, Central and Eastern regions and from tropical to subalpine (Press *et al.*, 2000). Most of the species are reported from West to East. Many species are recorded in Central Nepal, while least species are recorded from Western Nepal. Some species have only been recorded, but there is no record of specimens in herbaria of Nepal (*Murdannia blumei*, *M. spirata*, *M. japonica*, *M. vaginata*, *Amischotolype hookeri*, *Pollia hasskarlii* and *Streptolirion volubile*). Among them, the herbarium specimens collected from different places of Nepal have been kept in Flora of Nepal Database (*Murdannia blumei*, *M. japonica*, *Amischotolype hookeri* and *Streptolirion volubile*).

Regarding distribution, *Cyanotis cristata* is new record in Western Nepal and *Commelina diffusa* is new record in Central Nepal. The herbarium specimens of *Rhopalephora scaberrima* has been obtained from East Nepal only. Among *Murdannia*, *M. vaginata* is only reported but there is no specimen to verify its distribution in Eastern Nepal. *M. japonica* and *M. blumei* have distribution only in Eastern Nepal based on herbarium studied.

The species recorded only from East are *Amischotolype hookeri* (Hasskarl) H. Hara and *Murdannia medica* (Loureiro) D. Y. Hong. The species which are recorded only from Central are *Commelina appendiculata* C.B. Clarke, *Commelina ensifolia* R. Br., *Commelina suffruticosa* Blume, *Cyanotis arachnoidea* C.B. Clarke, *Cyanotis thwaitesii* Hassk. and *Murdannia keisak* (Hassk.) Hand.-Mazz. However, information on collections of H. Hara *et al.* was obtained from the Flora of Nepal Database (*Murdannia blumei*, *M. japonica*, *Amischotolype hookeri* and *Streptolirion volubile*).

The elevation range from 180 to 3500m according to Press *et al.*, 2000. While, elevation based on herbarium collected and deposited, range from 100-2360m. The range of elevation in which most of the species are found is 1400-1900m.

Regarding phenology, the flowering is usually in June--September and fruiting in October-- December. This observation agrees to Flora of China and to some extent with Flora of Bhutan. The flowering time for the species of *Commelina*, *Cyanotis* and *Murdannia* found to be morning around 5am until 12pm. When sunlight was more the flowers faded earlier. Such studies agree with Faden (2000). The collections were done from early July till November. It is difficult to find species in late December till March.

The anatomy also played important role during the study in separating the genera and species into different groups based on the shape and arrangement of stomata (*Commelina* and *Murdannia* being grouped into type 1 with similar structure and *Cyanotis* being different from them, grouped into type 2).

In *Commelina*, the arrangement of subsidiary cells and the shape of the stomata help in separating the species from other species of Commelinaceae. The stomata are six celled, brachyparahexacytic. This feature matches the findings of Tomlinson (1966). The shape of the stomata due to arrangement of six cells helped in separating the species of the *Commelina*.

The arrangement of subsidiary cells *Cyanotis* help in separating the species from other species of Commelinaceae. The stomata are four celled, paratetracytic. This feature matches the findings of Tomlinson (1966). The shape and arrangement of stomata and

other anatomical features are not taxonomically significant in separating the species of *Cyanotis*.

In *Murdannia*, the stomata are six celled, brachyparhexacytic. This feature matches the findings of Tomlinson (1966). The shape of the stomata is useful in separating the species of *Murdannia*.

A new method has been applied for pollen analysis by using Benzoyl Peroxide (5 gel) as a major chemical. This new method is cheap, easily available and very useful in separating the genus and species of Commelinaceae (tests carried on species of *Commelina*, *Cyanotis* and *Murdannia*).

The species were grouped into 3 major groups on the basis of shape of the pollen (type 1: kidney shape; type 2: circular shape and type 3: oval shape). The shape of the pollen in this method also helped in separating the species of *Commelina*, *Cyanotis* and *Murdannia*. However, the distinct features were not observed due to lack of SEM.

The phytochemical tests also seem to be helpful in separating the genera (*Cyanotis*, *Murdannia* and *Commelina*). Nevertheless, such study require large amount of collections, therefore, only some species were studied. From the phytochemical study, some species of *Commelina* (*C. benghalensis* and *C. maculata*) showed the presence of reducing sugar while the species of *Cyanosis* (*C. vaga*) and *Murdannia* (*M. nudiflora*) showed absence of reducing sugar which is a finding not mentioned in any literature.

The cluster analysis (dendrogram: nearest neighbor) was done using morphological and anatomical data. From the analysis, it is clear that genera Haemodorum and Heteranthera are the outgroups. Out of 10 genera, 8 genera belong to clade 1 (Commelinaceae) and 2 genera belong to clade 2. The clade 1 of family Commelinaceae can be further be divided into 5 sub-clades. Sub-clade 1, 4 and 5 represented tribe Commelineae. The tribe Tradescanteae is represented by sub-clades 2 and 3.

The sub-clade 1 is branched into two groups consisting *Rhopalephora* on one side and *Murdannia* along with *Pollia* on the other side. Similarly, *Commelina* and *Floscopa* come in sub-clade 4 and sub-clade 5 respectively. This finding matched with the

findings of Evans *et al.*, 2000. However, the branching is not like that of the Evans *et al.*, 2000. This might be because of less characters selected during the study.

The *Streptolirion* is in sub-clade 2 within tribe Tradescanteae. Similarly, subclade 5 is branched and consist of *Cyanotis* and *Amischotolype*. Evans *et al.*, 2000 showed that *Streptolirion*, *Cyanotis* and *Amischotolype* belong to tribe Tradescanteae but grouped into sub-tribes Streptoliriinae, Cyanotinae and Coleotrypinae respectively.

4.1.1 New Record and Doubtful Species

From the present study, 8 new records including 7 species and 1 variety has been added in Nepal Flora. The 8 new records for Nepal Flora include *Murdannia dimorphoides*, *M. medica*, *Commelina appendiculata*, *C. ensifolia*, *Cyanotis fasciculata*, *C. arachnoidea*, *C. thwaitesii* and *Murdannia spirata* var. *parviflora*. There are two doubtful species (*M. vaginata* and *Pollia hasskarlii*) which require further study.

Among *Commelina*, two species (*C. appendiculata* and *C. ensifolia*) have been found during the study. The *C. ensifolia* is found in especially partial shade and sandy places. It is different from other species in having ovate-lanceolate leaves, sheath long, diffused stem, capsule 3 seeded. The *C. appendiculata* is different from other species of *Commelina* in having lanceolate leaves, appendiculata and conduplicate spathe, capsule 2 locular with one seed each and seeds having whitish appendage at both ends.

Three new records of *Cyanotis* (*C. arachnoidea*, *C. fasciculata* and *C. thwaitesii*) have been found during the study. The *C. arachnoidea* differ from other *Cyanotis* in having short undeveloped stem and dense hairs present on leaves and bracts. The *C. thwaitesii* is similar to *C. fasciculata* but differs in having cobwebby hairs all over the body, inflorescence axillary, bracteoles lanceolate, bracts exceeding the cincinni, filament with swelling below the tip and capsule darker. But *C. fasciculata* is covered by silky hairs (not as dense as that of *C. thwaitesii*)

Among *Murdannia*, three new records include (*M. dimorphoides* and *M. medica*) and one variety (*M. spirata* var. *parviflora*) has been found during the study. The *M. dimorphoides* is very close to *M. nudiflora* and *M. spirata*; however, it differs from other species of those species from its often-whorled cincinni, bicoloured antherode, lacking dark veins in petals, and bearded stamens. Therefore, it need further study.

M. spirata var. *parviflora* differs from *M. spirata* in having the definite base in the plant; small flowers lacking stamen dimorphism. It also differs from all other species of *Murdannia* in having less broad leaves. Therefore, it need further study.

M. medica is distinct from other species of *Murdannia* from peculiar inflorescence and floral structure. The elongate bladeless sheaths enclosing one flowered cincinni, 4 sub equal staminodes and trilobed antherode are diagnostic characters of the *Murdannia medica*. This species is very close to *M. vaginata*. Therefore, it need further study.

Among *Commelina maculata*, two species collected each from Tatopani (leaves looking oily and ovate J.P. Gajurel 270, fig. 39 a) and Dakshinkali (sheaths have dense brown to red long hair at the summit J.P. Gajurel 94, fig. 39 b) have some different characters. Thus, these species could be new record but there is need of further study.

In some collections of *Commelina benghalensis* from Dolalghat, the petals have sky blue (slightly light, J.P. Gajurel 187, fig. 39 c) colour. This might be the new record, which is quite different from others. It need further study.

Among *Cyanotis cristata*, one species collected from the Dolalghat have leaves broad, glabrous and erect (J.P. Gajurel 189, fig. 39 J). These could be new record but require further study. Another specimen collected from Ilam, has reddish stem (J.P. Gajurel 277, fig. 39 K). It could not be confirmed due to shortage of literatures and specimens to verify. Therefore, it need further study.

One specimen of *Cyanotis fasciculata* collected from Shivapuri (J. P. Gajurel *et al.* 301, fig. 39 L) had no woolly bracts. This specimen can also be new record. It need further study.

Murdannia nudiflora collected from Jhapa (J.P. Gajurel 275, fig. 39 R) is different in size. It is large, the leaves are linear elongated and slightly ciliate at margin. These species could be either new species or new record. It could not be confirmed due to shortage of literatures and specimens to verify. Therefore, it need further study.

4.1.2 Nomenclatural Changes and Updating of Checklist

Some nomenclatural changes have been observed during the study. The genus *Amischophacelus axillaris* (L.) Rao & Kammathy cited in Press *et al.* (2000) should be kept as synonym of *Cyanotis axillaris* (L.) D. Don ex Sweet although some of the

literature from India and nearby countries continues to do so (Faden, 1998); and not as distinct genus *Amischophacelus*. The genus *Amischophacelus* is no longer recognized as distinct, All the characters as described in *Amischophacelus axillaris* (L.) Rao & Kammathy resemble to that of *Cyanotis axillaris* (L.) D. Don ex Sweet.

The characters like tubular petals and linear leaves help in recognizing the genus as *Cyanotis*. Its other characters like the inflorescence enclosed within the leaf sheaths (axil), beaked and stipitate capsule makes it distinctive. Therefore, the name of the species should be *Cyanotis axillaris* (L.) D. Don ex Sweet

Similarly, *Commelina hasskarlii* C. B. Clarke should be kept as synonym of *Commelina caroliniana* Walter. This species was described from USA, where it is a weed, more than 100 years before it was described from India where it is native (Faden 1989). The *C. hasskarlii* was not described until almost a century after *C. caroliniana*; the latter name must be taken up as the correct name for the Nepalese species.

Similarly, *Murdannia scapiflora* (Roxb.) Royle has undergone nomenclatural change as *Murdannia edulis* (Stokes) Faden.

The genus *Dictyospermum* is quite distinct from *Rhopalephora*. (Faden, 1998). *Rhopalephora* is separable from *Dictyospermum* by stem creeping; leaves spirally arranged; sub-petiolate or absent; apex acuminate; petals sub equal; its inflorescence form and its cincinnus bracts persistent; fruiting pedicels longer than the capsules; petals clawed; filaments long; capsule bivalved.

One of the specimens deposited in KATH resembles the characters of genus *Rhopalephora* (*Rhopalephora scaberrima* (Blume) Faden). However, the name in the specimen is written as *Dictyospermum scaberrimum* (Blume) H. Hara. It was confirmed by seeing the specimens deposited at K. Therefore, the genus *Rhopalephora* must be included in the checklist and *Dictyospermum scaberrimum* should be kept as synonym of *Rhopalephora scaberrima* (Blume) Faden.

4.2 Conclusion

The previous literature Hara, 1978 enumerated nine genera of family Commelinaceae with twenty-one species. Similarly, Press *et al.*, 2000 enumerated nine genera and twenty-two species. Present study confirms presence of eight genera (*Amischotolype*, *Commelina*, *Cyanotis*, *Rhopalephora*, *Floscopa*, *Murdannia*, *Pollia* and *Streptolirion*) and 30 taxa (29 species and 1 variety: *Amischotolype hookeri*, *Commelina benghalensis*, *C. diffusa*, *C. caroliniana*, *C. appendiculata*, *C. ensifolia*, *C. maculata*, *C. paludosa*, *C. suffruticosa*, *Cyanotis fasciculata*, *C. arachnoidea*, *C. thwaitesii*, *C. cristata*, *C. vaga*, *C. axillaris*, *Rhopalephora scaberrima*, *Floscopa scandens*, *Murdannia blumei*, *M. divergens*, *M. japonica*, *M. keisak*, *M. nudiflora*, *M. dimorphoides*, *M. medica*, *M. edulis*, *M. spirata*, *Murdannia spirata* var. *parviflora*, *M. vaginata*, *Pollia hasskarlii*, and *Streptolirion volubile*).

Present study also adds eight new records for Nepal Flora including *Murdannia dimorphoides*, *M. medica*, *Commelina appendiculata*, *C. ensifolia*, *Cyanotis fasciculata*, *C. arachnoidea*, *C. thwaitesii* and *Murdannia spirata* var. *parviflora*. However, *Murdannia vaginata* and *Pollia hasskarlii* are doubtful species, which require further study. Furthermore, the present study, adds different specimens of Commelinaceae in TUCH and KATH (*C. suffruticosa* and *Murdannia keisak*) collected from different localities, which were only reported but the specimens were never found in the herbaria of Nepal. The study further adds the specimens of new records to Flora of Nepal in herbaria of Nepal.

Morphological characters are very important in identifying and separating genera and the species of the family Commelinaceae. Anatomy of leaves (stomata) has been useful in separating genera; however, further study is essential in those genera, which are not available either due to absence in our herbaria or shortage of the specimens.

Palynological studies based on new method have yielded results interesting from taxonomic point of view. The shape of the pollen in this method also helped in separating the species of *Commelina*, *Cyanotis* and *Murdannia*. The phytochemical tests also can be helpful in separating genus as well as species.

Regarding distribution, many species are recorded in Central Nepal while least species are recorded from Western Nepal. Some species were only recorded in Central Nepal and some only in Eastern Nepal. The range of elevation in which most of the species are found is 1400-1900m. New method of preserving flowers without the use of spirit has helped in preserving the flowers of many species of Commelinaceae during the study. The flowering time for the species of *Commelina*, *Cyanotis* and *Murdannia* found to be morning around 5 am till 12 pm which was observed during the study.

The cluster analysis (dendrogram: nearest neighbors) of genera of Commelinaceae in Nepal helped to generate the basic idea on the relationship of the genera within the family. During the study, it was found that there are two basic groups or tribes on which the genera of the Nepalese species can be grouped (tribe Commelineae and tribe Tradescanteae).

Some nomenclatural changes have been observed during the study. The species *Amischophacelus axillaris* (L.) Rao & Kammathy should be kept as synonym of *Cyanotis axillaris* (L.) D. Don ex Sweet. Similarly, *Murdannia scapiflora* (Roxb.) Royle has undergone nomenclatural change as *Murdannia edulis* (Stokes) Faden. The *Commelina hasskarlii* C. B. Clarke is synonym of *Commelina caroliniana* Walter. The genus *Dictyospermum* is quite distinct from *Rhopalephora* (Faden, 1998). Therefore, *Dictyospermum scaberrimum* should be kept as synonym of *Rhopalephora scaberrima* (Blume) Faden.

The findings of the study are based on personal collections of author from more than 50 different places covering 14 districts (at least one place or more from each district), different herbarium specimens from different herbaria and literatures. The collections cover 18 species and 1 variety belonging to 4 genera of Commelinaceae from Central and Eastern Nepal. Therefore, present study supports possibility of finding new records and new species if explorations are carried extensively in Nepal. More literatures and time is also essential for the solving then problems related with doubtful species.

The systematic study helps in updating the enumeration of taxa, nomenclature changes, distribution, synonym, morphological changes, etc. From the present study all those recent changes has been noticed and treated accordingly.

4.3 Recommendations

As the collection of Commelinaceae need more care, the new method of collection should be implemented to improve the collections in the herbaria. The future collections of Commelinaceae would be improved if more material per specimen were collected, plants should be collected with bases with more consistency, expanded notes so to make more observations on the plants, for example, recording the time of day that were they flowering.

There are some specimens, which are reported by foreign collectors and are deposited in herbaria outside Nepal but their duplicates are not in Nepal. It is therefore recommended that Plant Quarantine Office and Department of Plant Resource must work with herbaria of Nepal and confirm that the specimens, which go out of Nepal, have their duplicate in Nepal.

The chemical for pollen analysis should be made available. The collections at TUCH and KATH should be properly kept so as to keep them safe. There is less information on label in deposited herbarium, which could be vital during the study. Thus, the author has developed new label, which contains most of the information about the species, which is recommended in future collections.

Lack of information on type is important point, which slowed the study. Therefore, there must be a mechanism so that at least we could get easy access to the information on Type. The library at CDB, KATH and Central Library lack recent literatures and information on types. So, it is needed to increase the literatures. It is also needed to update the checklist of Flowering Plants of Nepal.

CHAPTER V SUMMARY

Commelinaceae is a medium size family with 41 genera and 650 species worldwide. Commelinaceae is distributed worldwide, mostly tropical and subtropical with considerable diversity extending into northern temperate regions. In Nepal, it is distributed from West to East and dominant in altitude 1400m-1900m.

The previous literatures Hara, 1978 and Press *et al.*, 2000 enumerated nine genera of family Commelinaceae with twenty-one species and twenty-two species respectively. Present study confirms presence of 8 genera and 30 taxa (29 species along with one variety). Among them two species are doubtful and require further study.

The study adds eight new records for Nepal Flora including *Murdannia dimorphoides*, *M. medica*, *Commelina appendiculata*, *C. ensifolia*, *Cyanotis fasciculata*, *C. arachnoidea*, *C. thwaitesii* and *Murdannia spirata* var. *parviflora*. Among them 7 seven species are collected by the author for the first time. Similarly, it adds some specimens in TUCH and KATH of Commelinaceae (*C. suffruticosa* and *Murdannia keisak*), which were recorded but not present in herbaria of Nepal.

The findings of the study are based on personal collections of author and different herbarium specimens from different herbaria and literatures. The author has collected 19 species and 1 variety from more than 50 different places covering 14 districts along with more than 300 collections. Therefore, present study supports possibility of finding new records and new species if explorations are carried extensively in Nepal.

New method of preserving flowers without the use of spirit has helped in preserving the flowers of many species of Commelinaceae during the study. Regarding phenology, the flowering is usually in June--September and fruiting in October-- December. The flowering time for the species of *Commelina*, *Cyanotis* and *Murdannia* found to be morning around 5am till 12pm.

Besides morphological study, anatomical study, phytochemical study, pollen study (based on new method) and cluster analysis have yielded results interesting from taxonomic point of view. The phytochemical tests also can be helpful in separating genus as well as species.

Some nomenclatural changes include *Amischophacelus axillaris* (L.) Rao & Kammathy kept as synonym of *Cyanotis axillaris* (L.) D. Don ex Sweet; *Murdannia scapiflora* (Roxb.) Royle has undergone nomenclatural change as *Murdannia edulis* (Stokes) Faden. Similarly, *Commelina hasskarlii* C. B. Clarke is synonym of *Commelina caroliniana* Walter. The *Dictyospermum scaberrimum* should be kept as synonym of *Rhopalephora scaberrima* (Blume) Faden.

The author believes the current study on commelinaceae would help in better understanding the family in Nepal. It further helps in arranging the nomenclature changes and to update the checklist. New methods of preserving flower and pollen analysis may help for other families as well. With very short period of time, the work has been carried out. Therefore, the work on Commelinaceae should continue with all supports that would help in systematic study.

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Web sites

-) Annotated Checklist of Flowering Plants of Nepal Electronic Version: http://www.efloras.org/flora_page.aspx?flora_id=110
-) Flora of China Electronic Version: http://www.efloras.org/flora_page.aspx?flora_id=2
-) Flora of Commelinaceae in Flora of North America Electronic Version: http://www.efloras.org/flora_page.aspx?flora_id=1
-) Flora of Nepal: rbg-web2.rbge.org.uk/nepal/floraofnepal/index.html.
-) Flora of Pakistan Electronic Version: http://www.efloras.org/flora_page.aspx?flora_id=5
-) Flora of Taiwan Electronic Version: http://www.efloras.org/flora_page.aspx?flora_id=101
-) Wikipedia: www.wikipedia.org/wiki/Commelina_caroliniana

APPENDIX

A. Some Illustrations:



Fig 39. A-B: *Commelina maculata* Edgew. A. Spathe smooth (J. P. Gajurel 270), B. Presence of dense reddish brown hairs (J. P. Gajurel 94); C-F: *Commelina benghalensis* L.: C. Petal colour different (J. P. Gajurel 187), D. leaves similar to *Cyanotis cristata* (J. P. Gajurel 188), E. Cleistogamous flowers (J. P. Gajurel 187). G. *Commelina paludosa* Blume: Reddish brown hairs present on sheath of both species (J. P. Gajurel et al. 299); H. *Commelina caroliniana* Walter: with central dark spot (J. P. Gajurel 206); I. Linear leaves in *C. appendiculata* C.B. Clarke (J. P. Gajurel 209).



Fig. 39. J-L: *Cyanotis cristata* (L.) D. Don: J. Leaves broader (J. P. Gajurel 189), K. Reddish stem (J. P. Gajurel 291), L. Smallest (277); MNO: *Cyanotis vaga* (Lour.) J. A. & J. H. Schult: M. With 3 petals (J. P. Gajurel et al. 130), N. Pink flower (J. P. Gajurel et al. 222), O. With 4 petals (J. P. Gajurel 220); P: With undeveloped stem (J. P. Gajurel et al. 264); Q: *Cyanotis fasciculata* (Hayne ex Roth) Schultes: Q. Less pubescent (J.P. Gajurel et al. 301); R: *Commelina maculata* Edgew. R. Large specimen (J. P. Gajurel 275)

Fig. 40 Species of Commelina



Commelina maculata



C. benghalensis



C. appendiculata



C. diffusa



C. caroliniana



C. suffruticosa



C. paludosa



C. ensifolia

Fig. 41 Species of Cyanotis and Murdannia



Cyanotis vaga



C. cristata



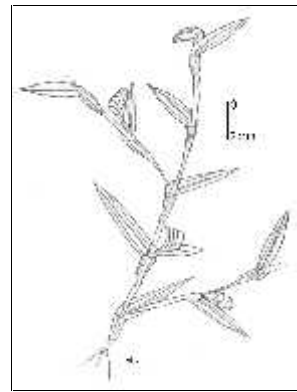
C. fasciculata



C. arachnoidea



C. thwaitesii



C. axillaries



Murdannia spirata



M. divergens



M. nudiflora

Fig. 42 Other Species



M. keisak



M. dimorphoides



Murdannia spirata var. parviflora



M. medica



M. edulis

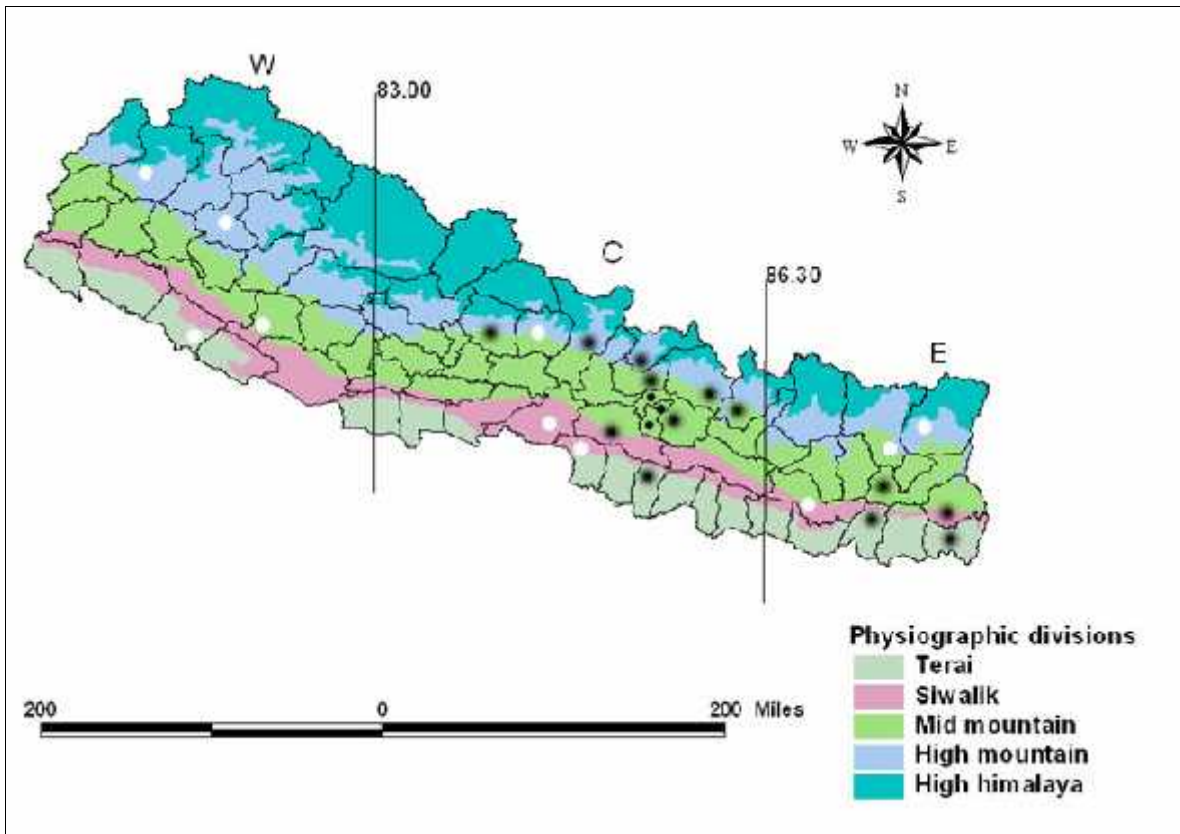


Rhopalephora scaberrima



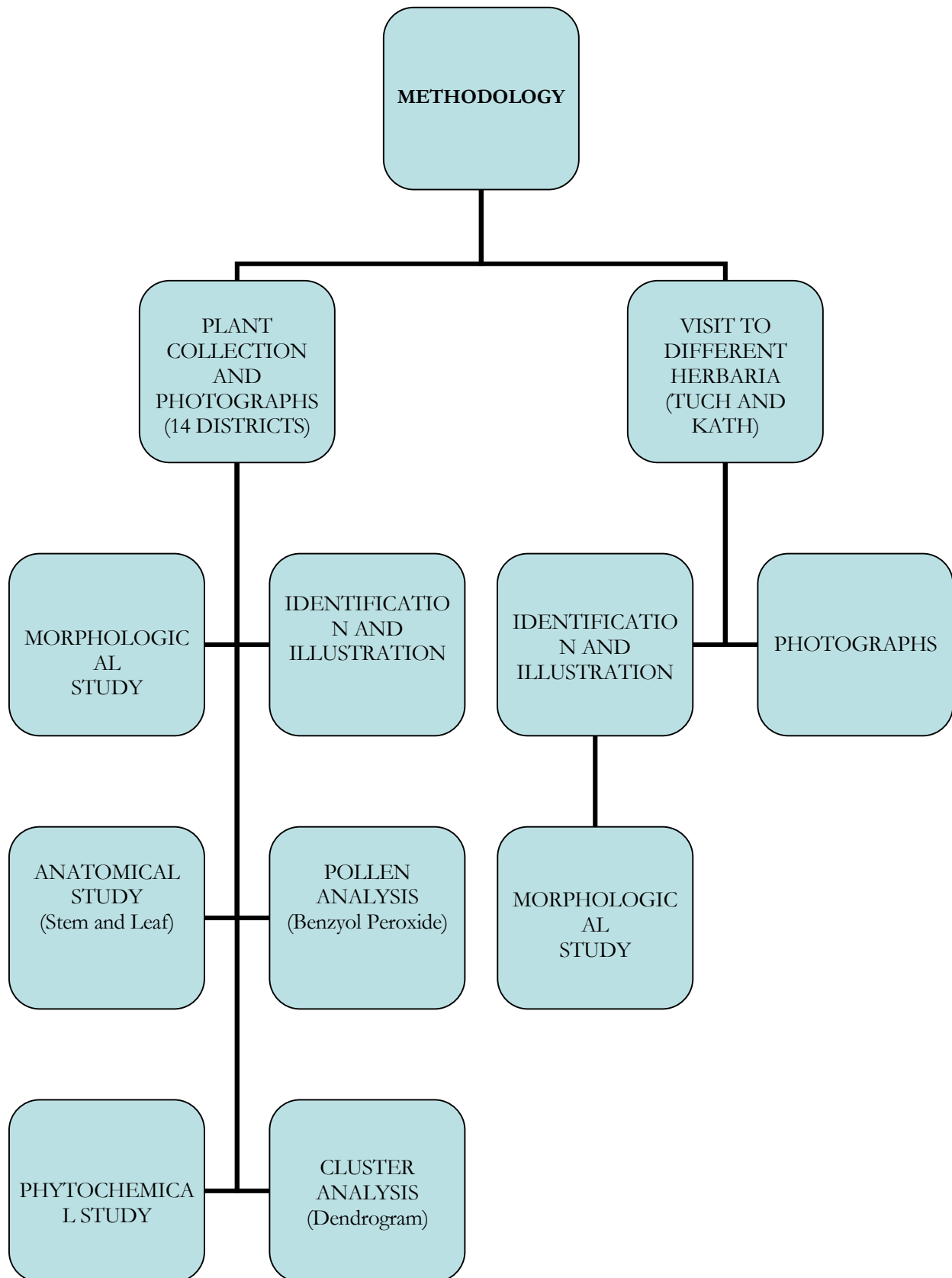
Floscopa scandens

Fig. 43 Distribution of Species of Commelinaceae in Nepal



Distribution of species of Commelinaceae in Nepal based on the Collections of the author (black dots) and herbarium deposited in different herbaria of Nepal (white dots).

Fig. 44 Flow Chart of Methodology



(B) Requirements and methodology for Anatomical Study

The different glassware, chemicals required for anatomical study includes test-tubes with stand, Beaker 250ml, Petri-dish, Watch glass, Slides, Cover-slip, Blotter pieces, and Spirit lamp. The chemicals required include Absolute alcohol, Alcohol-90%, Safrannin, Light green, Glycerin pure, Xylene, and DPX.

Procedure for preparing permanent slide is given below:

Alcohol 30%(25 minutes) Alcohol 50%(25 minutes) Alcohol 70%(25 minutes)
Safranin(25 minutes) Wash with Alcohol 70% Alcohol 90%(25 minutes) Light green
(2minutes) Wash with Alcohol 90% Alcohol 100%(25 minutes) Test in Xylene Mount
in DPX (If ppt.appears) Redo the dehydration process. Mount in DPX

(C) Requirements and methodology for Pollen Analysis

For pollen analysis, Benzoyl Peroxide 5 gel, Glycerine, Slides, and Coverslips were required. The anthers were kept in a small tube containing 10 ml of glycerin and water for 12 hours to regain the shape of pollens. 4ml of Benzoyl Peroxide (Persol 5 gel) was taken in a tube and 4 ml of water was mixed.

The mixture was slowly stirred. The anthers were kept in a small tube containing mixture as prepared above. Then the tube was kept in microwave oven in 800W for about 20 seconds. Then the tube was taken out and the anthers were washed and kept in a watch glass. 2ml of Safranin was added in the solution and kept for 2 minutes.

Then the anther was kept in a watch glass and crushed with needle. It was mounted in a slide with glycerin. Finally, the slide was observed under microscope with magnification 150X and 1000X.

(D) Requirements and methodology for Phytochemical Tests

The different chemical and glassware required during the phytochemical were test tubes, beakers, FeCl₃ solution, Methanol, Maeyer' reagent, distilled water, and Conc. HCl, Magnesium ring.

The aerial part of the species of the different genera of the Commelinaceae were taken and dried in the oven. The dried parts were grinded. 200mg of the dried part was taken in the beaker with 10ml of the methanol. The extract was kept overnight and it was filtrated. The filtrate was taken and the respective tests were done.

Test for alkaloid (Dragendorff's reagent)

The extract solution was treated with Dragendorff's reagent (1 drop). Distinct precipitate was formed showing the presence of alkaloids. The extract solution (2 drops) was treated with Maeyer's reagent (3 drops). Heavy precipitate appeared indicating the presence of alkaloids.

Test for reducing sugars (Fehlings test)

The extract solution (0.5 ml) was treated with Fehling's solution (1 ml) in a test tube. The whole mixture was heated strongly on water bath. Red precipitate was formed showing the presence of reducing sugars.

Saponins (froth test): The aqueous extract (2 ml) was shaken vigorously for 30 seconds in a test tube of 1 cm diameter . Persistence of thick froth (about 1 cm) height even after 30 seconds indicated the presence of saponins.

Test for flavonoids

Shinoda's test: Extract solution (1 ml) was treated with a pinch of magnesium powder in presence of concentrated hydrochloric acid (5 drops). Red coloration was seen indicating the presence of flavonoids.

Shibata's test: Extract solution was treated with a pinch of a zinc dust in presence of concentrated hydrochloric acid (5 drops) separately. Red coloration was observed indicating the presence of flavonoids.

Test for quinones

The extract solution (1ml) was treated with a colorless solution of ferrous sulphate (1ml) , ammonium thiocyanate crystals (1 or 2 grains) and concentrated sulphuric acid (1 drop) in a test tube . Formation of red coloration showed the presence of quinones.

E. CLUSTER ANALYSIS

Table 2: Character Coding

S. N.	Characters	Coding
1.	Habit of the plant	0= Decumbent to erect 1=Climber
2.	Inflorescence peduncle	0=Well developed 1=absent or nearly so
3.	Cincinnus bract development	0=cincinnus bract small 1=cincinnus bract foliaceous
4.	Flower Symmetry	0=actinomorphic; 1=zygomorphic
5.	Pedicel presence or absent	0= flowers pedicellate 1=flowers sessile
6.	Inflorescence	0=Enclosed in spathe 1=not enclosed in spathe
7.	Leaves surface	0=glabrous 1=pubescent
8.	spathe surface	0=glabrous 1=pubescent
9.	Petals fusion	0=free 1=fused
10.	petal colour	0=white to blue 1=deep blue to pink
11.	petal size	0=equal or subequal 1=one strongly differentiated
12.	petal morphology	0=not clawed 1=clawed
13.	stamen fertility	0=all fertile 1=all not fertile
14.	Stamen filament surface	0=glabrous 1=pubescent
15.	Stamen filament swelling	0=without swelling below tip 1=with swelling below tip
16.	Stamen symmetry	0=actinomorphic at anthesis 1=zygomorphic at anthesis
17.	Carpel swelling	0=without swelling below tip 1=with swelling below tip
18.	Locules in carpel	0= with 3 locules 1=with 2 locules
19.	seed arrangement	0=uniseriate 1=bisseriate
20.	Seed number per locule	0=more than two seeds per locules 1=two seeds per locule; 2=1 seed per locule
21.	Seed hilum	0= elliptic 1= oblong to linear
22.	Stomata cells	0= two celled 1=four celled; 2=six celled
23.	Leaves arrangement	0=spiral arrangement 1= alternate arrangements

Table 3: Cluster Analysis

Characters		Genera of Commelinaceae and Respective Codings									
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.	Habit of the plant	0	0	0	0	0	0	0	0	0	1
2.	Inflorescence peduncle	0	0	1	0	1	0	0	0	0	0
3.	Cincinnus bract development	1	0	0	1	1	1	0	0	0	1
4.	Flower Symmetry	0	0	0	1	0	0	0	0	1	1
5.	Pedicel presence or absent	0	1	1	0	1	0	0	0	0	1
6.	Inflorescence	0	0	1	0	1	1	1	1	1	0
7.	Leaves surface	0	0	0	1	1	1	1	1	1	0
8.	Spathe surface	0	0	0	1	0	0	0	0	0	1
9.	Petals fusion	0	0	0	0	1	0	0	0	0	0
10.	Petal colour	0	0	0	0	1	0	0	0	0	0
11.	Petal size	0	0	0	1	0	1	0	0	0	0
12.	Petal morphology	0	0	0	1	0	0	0	1	1	1
13.	Stamen fertility	0	0	0	1	0	1	1	1	1	0
14.	Stamen filament surface	0	0	1	1	1	0	1	0	1	1
15.	Stamen filament swelling	0	0	0	0	1	0	1	0	0	0
16.	Stamen symmetry	0	0	0	0	0	0	1	1	0	0
17.	Carpel swelling	0	0	0	0	1	0	0	0	0	0
18.	locules in carpel	0	0	0	0	0	1	0	0	1	0
19.	Seed arrangement	1	1	0	1	0	1	0	0	0	0
20.	Seed number per locule	1	0	1	2	1	2	0	0	0	0
21.	Seed hilum	0	0	1	1	0	1	0	0	1	1
22.	Stomata cells	0	0	1	2	1	2	2	2	2	2
23.	Leaves arrangement	0	0	1	0	0	1	1	1	1	1

(1. *Heteranthera*, 2. *Haemodorum*, 3. *Amischotolype*, 4. *Commelina*, 5. *Cyanotis*, 6. *Floscopa*, 7. *Murdannia*, 8. *Pollia*, 9. *Rhopalephora* and 10. *Streptolirion*)

Table 1: Distributions of Genera and Species of Commelinaceae in some Countries or States

S.N.	Country or State	Total Genera	Total Species
1.	China (Fl. Ch.)	15	59
2.	Nepal(Ann. Check. Fl. Nep.)	8	23
3.	India (Fl. Br. India)	7	76
4.	Bhutan (Fl. Bhu.)	11	29
5.	Pakistan (Fl. Pak.)	7	38
6.	Ceylon (Revised Fl. Cey.)	16	38
7.	Taiwan (Fl. Tai.)	7	25
8.	North America (Fl. N. A.)	7	25

(data obtained from www.efloras.org. And literatures)

CHECKLIST

COMMELINACEAE R. Br., Prodr. 268, 1810.

AMISCHOTOLYPE Hasskarl, Flora. **46**: 391. 1863.

Amischotolype hookeri (Hasskarl) H. Hara, Fl. Eastern Himal. **1**: 399. 1966.

Forrestia hookeri Hassk. = **Amischotolype hookeri** (Hasskarl) H. Hara

COMMELINA Plum. Ex. L., Gen. Pl. ed. 5. 25. 1754.

Commelina appendiculata C.B. Clarke, Commel. And Crypt. Beng. **13**. 1874.

Commelina benghalensis L., Sp. Pl. **1**: 41. 1753.

Commelina caroliniana Walter, Flora Caroliniana, Secundum : 68. 1788.

Commelina hasskarlii C. B. Clarke. = **Commelina caroliniana** Walter

Commelina diffusa N. L. Burman, Fl. Indica. **18**, pl. 7, fig. 2. 1768.

Commelina communis Dalz & Gibs. = **Commelina diffusa** N. L. Burman

Commelina nudiflora Hook. F. = **Commelina diffusa** N. L. Burman

Commelina salciflora Thw. = **Commelina diffusa** N. L. Burman

Commelina ensifolia R. Br., Prodr. 269. 1810. Hook, Fl. Brit. Ind. **6**: 374. 1892.

Commelina maculata Edgew., Trans. Linn. Soc. Lond. **20**: 89 .1846.

Commelina obliqua var. *viscida* C.B. Clarke = **Commelina maculata** Edgew.

Commelina paludosa var. *viscida* (C. B. Clarke) Rao & Kammathy = **Commelina maculata** Edgew.

Commelina paludosa Blume, Enum. Pl. Jav. **1**: 2 .1827.

Commelina donii A. Dietr.= **Commelina paludosa** Blume

Commelina obliqua Buch.-Ham. ex D. Don = **Commelina paludosa** Blume

Commelina suffruticosa Blume, Enum. Pl. Jav. **1**: 3. 1827.

CYANOTIS D. Don, Prodr. Fl. Nepal. **45**. 1825.

Cyanotis arachnoidea C.B. Clarke, in A. De Candolle and C. De Candolle, Monogr. Phan. **3** : 250. 1881.

Cyanotis axillaris (L.) D. Don ex Sweet, Hort. Brit. **430**. 1826.

Amischophacelus axillaris (L.) Rao & Kammathy = **Cyanotis axillaris** (L.) D. Don ex Sweet

Tradescantia axillaries(L.) L. = **Cyanotis axillaris** (L.) D. Don ex Sweet

Zygomenes axillaris L. = **Cyanotis axillaris** (L.) D. Don ex Sweet

Cyanotis cristata (L.) D. Don, Prodr. Fl. Nepal.: **46**. 1825.

Tradescantia cristata L. = **Cyanotis cristata** (L.) D. Don

Cyanotis fasciculata (Hayne ex Roth) Schultes f., Syst. Vii **1152**. 1830.

Cyanotis thwaitesii Hassk., Commel. Ind. **136**. 1870. Hook, Fl. Brit. Ind. **6**: 388. 1892.

Cyanotis vaga (Lour.) J. A. & J. H. Schult., Syst. Veg. **2**: 1153. 1830.

Cyanotis barbata D. Don = **Cyanotis vaga** (Lour.) J. A. & J. H. Schult.

FLOSCOPA Loureiro, Fl. Cochinch. **1**: 189, 192. 1790.

Floscopa scandens Loureiro, Fl. Cochinch. **1**: 193. 1790.

Aneilema hispida D. Don = **Floscopa scandens** Loureiro

Floscopa hamiltonii (Spreng.) Hassk. = **Floscopa scandens** Loureiro

Tradescantia paniculata Roxb. = **Floscopa scandens** Loureiro

MURDANNIA Royle, Illus.Bot. Himalayan

Murdannia blumei (Hassk.) Brenan, Pl. **36**: 3578. 1962.

Aneilema blumei (Hassk.) Bakh. f. = **Murdannia blumei** (Hassk.) Brenan

Aneilema hamiltonianum Wall. ex C. B. Clarke = **Murdannia blumei** (Hassk.) Brenan

Murdannia divergens (C. B. Clarke) Bruc., Engler & Prantl, Nat. Pflanzenfam., ed. 2. **15a**: 173.

Aneilema divergens (C. B. Clarke) C. B. Clarke. = **Murdannia divergens** (C. B. Clarke) Bruc.

Aneilema longifolium Wall. = **Murdannia divergens** (C. B. Clarke) Bruc.

Murdannia edulis (Stokes) Faden, Taxon **29** (1): 77. 1980.

Aneilema scapiflorum (Roxb.) Kostel. = **Murdannia edulis** (Stokes) Faden

Commelina edulis Stokes = **Murdannia edulis** (Stokes) Faden

Murdannia japonica (Thunb.) Faden, Taxon **26**: 142.1977.

Aneilema lineolatum (Blume) Kunth = **Murdannia japonica** (Thunb.) Faden

Murdannia elata (Vahl) Bruckn. = **Murdannia japonica** (Thunb.) Faden

Commelina elata Vahl = **Murdannia japonica** (Thunb.) Faden

Murdannia keisak (Hassk.) Hand.-Mazz., Symb. Sin. **7**: 1243 (1936).

Aneilema keisak Hassk. = **Murdannia keisak** (Hassk.) Hand.-Mazz.

Murdannia medica (Loureiro) D. Y. Hong, Acta Phytotax. Sin. **12**: 470. 1974.

Murdannia nudiflora (L.) Brenan. Kew Bull. 1952 : 189. 1952.

Commelina nudiflora L. = **Murdannia nudiflora** (L.) Brenan.

Aneilema nudiflorum (L.) R.Br. = **Murdannia nudiflora** (L.) Brenan.

Tradescantia malabarica L. = **Murdannia nudiflora** (L.) Brenan.

Commelina nudicaulis Burm. F. = **Murdannia nudiflora** (L.) Brenan.

Murdannia malabarica (L.) Bruckn. = **Murdannia nudiflora** (L.) Brenan.

Aneilema nudicaulis (Burm. F.) Loudon = **Murdannia nudiflora** (L.) Brenan.

Murdannia spirata (L.) Bruckn., Engler & Prantl, Nat. Pflanzenfam., ed. 2, **15a**: 173. 1930.

Commelina spirata L. = **Murdannia spirata** (L.) Bruckn.

Aneilema spiratum (L.) R.Br. = **Murdannia spirata** (L.) Bruckn.

Murdannia spirata (L.) Bruckn. var. **parviflora** Faden, Novon **11**: 22-30. 2001.

***Murdannia vaginata** (L.) Bruckn., Engler & Prantl, Nat. Pflanzenfam., ed. 2. **15a**: 173. 1930.

POLLIA Thunb., Nov. Gen. Pl. **1**: 11. 1781.
***Pollia hasskarlii** Hook., Fl. Brit. Ind. **3**: 289.
Pollia aclisia Hassk. = **Pollia hasskarlii** Hook.

RHOPALEPHORA Hasskarl, Bot. Zeitung (Berlin). **22**: 58. 1864.
Rhopalephora scaberrima (Blume) Faden, Phytologia **37**: 480. 1977.
Dictyospermum scaberrimum (Blume) J.K. Morton = **Rhopalephora scaberrima** (Blume) Faden
Aneilema protensum (Wight) Wall. ex C. B. Clarke = **Rhopalephora scaberrima** (Blume) Faden
Aneilema scaberrimum (Blume) Kunth = **Rhopalephora scaberrima** (Blume) Faden
Dictyospermum protensum Wight = **Rhopalephora scaberrima** (Blume) Faden
Lamprodithyros protensus (Wight) Hassk. = **Rhopalephora scaberrima** (Blume) Faden
Piletocarpus protensus (Wight) Hassk. = **Rhopalephora scaberrima** (Blume) Faden
Piletocarpus protensus var. *intermedius* Hassk. = **Rhopalephora scaberrima** (Blume) Faden

STREPTOLIRION Edgew. J. Proc. Linn. Soc. Lon. **1**: 254. 1845.
Streptolirion volubile Edgew., J. Proc. Linn. Soc. Lon. **1**: 254. 1845.
Streptolirion cordifolium (Griff.) Kuntze = **Streptolirion volubile** Edgew.
Tradescantia cordifolia (Griff.) O. Ktze. = **Streptolirion volubile** Edgew.
* DOUBTFUL SPECIES